REGISTRATION FOR MODIFICATION OF AN EXISTING TRUE MINOR OIL AND NATURAL GAS SOURCE IN INDIAN COUNTRY PART 2 APPLICATION FOR PRIMUS FACILITY: PETROSHALE US 8H, US 12H, AND US 13H OIL AND GAS PRODUCTION FACILITY, MCKENZIE COUNTY, NORTH DAKOTA

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PREPARED FOR

PetroShale (US), Inc.

PREPARED BY

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1 INTRODUCTION

PetroShale (US), Inc. (PetroShale) is submitting the Registration for New True Minor Oil and Natural Gas Source form and application to the U.S. Environmental Protection Agency (EPA) Region 8 to modify the existing PetroShale US 8H facility by adding the PetroShale US 12H and 13H wells to the oil and gas production facility (Primus) (the facility). The required EPA registration form Part 2 is being submitted in accordance with the Federal Minor New Source Review (NSR) Rule codified at 40 CFR §49.151 and is included in Appendix A. The Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources Part 1 form was submitted to the EPA on December 21, 2018.

The existing PetroShale US 8H well was completed December 29, 2016 and was registered with the EPA by PetroShale on July 20, 2018. PetroShale is adding two new wells, PetroShale US 12H and US 13H, within 1/4 mile of the existing PetroShale US 8H facility. Due to the proximity of the PetroShale US 12H and US 13H wells to the existing PetroShale US 8H well, the 3 wells are considered one facility: the Primus facility. Construction commenced on the PetroShale US 12H and US 13H wells at the end of December 2018. The PetroShale US 13H well was completed May 7, 2019. The PetroShale US 12H well was completed in June 2019 . Because the existing facility is located within the boundaries of the Fort Berthold Reservation and the modification commenced after October 3, 2016, the facility is registering a modification to an existing true minor oil and natural gas source per the Federal Indian Country Minor NSR Rule. All three wells are planned to operate at the facility.

Applicable attachments requested on the EPA registration form are included within this application. Section 2 of this application provides general facility information, a brief site description, and the site location. Section 3 provides a detailed process description of the operations and a discussion of the emission sources located at the newly modified existing facility. Section 4 provides a discussion of the methodology used for the emission calculations. Section 5 presents the potential to emit (PTE) and estimated actual annual emissions from the facility and compares the emissions to minor and major NSR thresholds. Section 6 reviews the requirements of the Federal Implementation Plan (FIP) for True Minor Oil and Natural Gas Sources in Indian Country and determines the applicability of each requirement to the facility. The Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources Part 2 form is included in Appendix A. Emission calculations are included in Appendix B. Supporting documentation, such as an oil and gas analyses, EPA Tanks 4.0.9d, and E&P TANK V2.0 modeling inputs and outputs, is included in Appendix C.

2 GENERAL FACILITY INFORMATION

The Primus facility is an oil and gas well facility consisting of the PetroShale US 8H, US 12H, and US 13H wells. The facility operates year-round and includes equipment and related processes used in the extraction, production, separation, and storing the oil from the wells. This equipment has the potential to release regulated pollutants to the atmosphere. The facility is classified under Standard Industrial Classification (SIC) Code 1311 (crude petroleum and natural gas) and North American Industry Classification System (NAICS) Code 211111 (crude petroleum and natural gas extraction). Information concerning each well is presented in Table 1.

Table 1. Well Information

Well Name	API Number	Completion Date	Status
PetroShale US 8H	33-053-07650	12/29/2016	Producing
PetroShale US 12H	33-053-07780	6/28/2019	Producing
PetroShale US 13H	33-053-07868	5/7/2019	Producing

Source: North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division

The Primus facility is located within the boundaries of the Fort Berthold Reservation, off Highway 23, approximately 12.5 miles west of New Town. Location information for the wells at the Primus facility is presented in Table 2. A site location map is included as Figure 1.

Table 2. Location Information

Well Name	County	Section Location	Latitude, Longitude	Elevation
PetroShale US 8H	McKenzie	NENW, S17, T152N, 94W	47.991647, -102.740876	2,155 feet
PetroShale US 12H	McKenzie	NWNE, S17, T152N, 94W	47.991499, -102.736705	2,175 feet
PetroShale US 13H	McKenzie	NWNE, S17, T152N, 94W	47.991498, -102.7365	2,175 feet

Note: Primus Facility: PetroShale US 8H, US 12H, and US 13H are within the boundaries of the Fort Berthold Reservation in North Dakota.

McKenzie County is designated by the EPA as being in attainment or unclassified with respect to the National Ambient Air Quality Standards (NAAQS) for ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). Thus, the Primus Facility is not subject to nonattainment NSR.

Figure 1. General Location of the Facility

3 PROCESS DESCRIPTION

This section provides a detailed description of the processes and equipment installed at the Primus facility. Emission sources located at the facility include both point and fugitive sources. The facility consists of the following primary production equipment and air pollutant emitting activities:

- One (1) separator with a 0.5 million British thermal units per hour (MMBtu/hr) heater treater fueled by produced gas;
- Two (2) separators with a 1.0 MMBtu/hr heater treater fueled by produced gas;
- One (1) 215-horsepower (hp) Caterpillar 3406NA engine fueled by natural gas;
- One (1) 400-hp Caterpillar 3408TA engine fueled by natural gas;
- Eight (8) 400-barrel crude oil/condensate storage tanks controlled by flares;
- Eight (8) 1,000-barrel crude oil/condensate storage tanks controlled by flares;
- Four (4) 400-barrel produced water storage tanks controlled by flares;
- Four (4) 1,000-barrel produced water storage tanks controlled by flares;
- Four (4) flares with 98% or greater control efficiency;
- Produced oil and gas sold via sales lines;
- Truck loading of produced water; and
- Flaring of the produced gas during upset conditions.

At the Primus facility, the produced fluids are flowing up the wellbores or are brought to the surface via the 400-hp Caterpillar 3408TA engine at PetroShale US 12H and US 13H wells and the 215-hp Caterpillar 3406NA engine at PetroShale US 8H. The produced fluids are routed via a closed system to a separator. A combination of higher temperatures and lower pressures allows for the separation of the components comprising the fluid stream. The separator reduces the pressure and heats the fluid stream to a desired temperature range to aid in the separation of oil, natural gas, and produced water. This treatment removes impurities and separates the phases to best meet sales delivery specifications for oil. The separation unit at PetroShale US 8H is heated by a 0.5 MMBtu/hr burner and fueled by produced gas. The separation units at PetroShale US 12H and 13H are each heated by 1.0 MMBtu/hr burners fueled by produced gas. The crude oil/condensate is temporarily stored in eight (8) 400-barrel storage tanks and eight (8) 1,000-barrel storage tanks before being sold via pipeline. The produced water is stored in four (4) 400-barrel storage tanks and four (4) 1,000-barrel storage tanks prior to being transported offsite by truck. The produced gas is sold via a sales gas line except during upset conditions. Four Steffes-engineered flares control the emissions from the production tanks and the produced gas (with a control efficiency of 98% or greater).

4 EMISSION CALCULATION METHODOLOGY

Emissions were estimated based on estimated annual production totals and the daily averages for monthly production data for the Primus Facility. The production data used in determining the facility emissions is presented in Table 3. Detailed production data is included in Appendix C.

Table 3. Well Production Data for Primus Facility: PetroShale US 8H, US 12H, and US 13H

Production Data for Estimating Basis		Days of Production	Total Oil, BBLs	Daily Oil Production Average, BOPD[1, 2]	Total Gas, MCF	Daily Gas Production Average, MCFD[1, 2]	Total Water, BBLs	Daily Water Production Average, BWPD[1, 2]
PTE	US 8H	34	43,434	766.48	59,494	1,049.89	9,927	175.18
	US 12H	30	35,421	708.42	43,525	870.50	3,235	242.63
	US 13H	44	42,428	578.56	97,574	1,330.55	25,675	350.11
	Combined	-	***121,283***	***2,053.47***	***200,593***	***3,250.95***	***38,837***	***767.92***
Estimated Actual Annual Emissions	US 8H	365	144,873	396.91	212,509	582.22	45,937	125.85
	US 12H	39	44,111	678.63	55,931	860.48	3,235 [3]	242.63 [3]
	US 13H	117	49,008	251.32	97,574	500.38	27,965	143.41
	Combined	-	***237,992***	***1,326.87***	***366,014***	***1,943.07***	***77,137***	***511.89***

[1] For PTE the daily production average assumes a 40% decline factor for the PetroShale US 8H, 12H, & 13H wells. Based on current operating conditions at the PetroShale US 8H well, it was conservatively assumed that 10% of the produced gas would be flared due to upset conditions and the rest sold via pipeline.
[2] The estimated actual annual emissions average daily production rate for the entire facility is based on the sum of the estimated actual daily production average for each well. The estimated actual daily production average was based on the most recent 12 months' of actual production for the PetroShale US 8H well. The estimated actual daily production average for the PetroShale US 12H well was based on the first 39 days of actual production. The estimated actual daily production average for the PetroShale US 13H well was based on the first 4 months of actual production.
[3] The total water production and estimated actual annual emissions average daily water production rate for the PetroShale US 12H well is based on the first 8 days of production only.

Emissions were estimated based on EPA AP-42 emission factors, E&P TANK V2.0 and EPA Tanks 4.0.9d tank emission models, manufacturer specifications, and site-specific facility data. Estimating the PTE used assumptions that differ from the assumptions used when estimating the actual facility emissions. The methodology for each is detailed below.

4.1 Potential to Emit

In lieu of day-specific production data, the PTE was calculated based on the monthly production data for the PetroShale US 8H well for December 2016 and January 2017 (the first 34 days of production for the PetroShale US 8H well), the first 30 days of production data for the PetroShale US 12H well, and the monthly production data for May and June 2019 for the PetroShale US 13H well (the first 44 days of production for the PetroShale US 13H well) to estimate the potential average daily production of oil, water, and gas for each well. An individual oil well usually produces at its maximum rate immediately following the first date of production and subsequently declines. A 40% decline factor was applied to the daily production average for each well to account for this decline. The production rates for each well were combined to estimate the production emissions for the entire facility with all three wells operating.

The PetroShale US 8H well was connected to a gas sales pipeline on May 11, 2018 and in the most recent 12 months of production, approximately 8.4% of the produced gas was flared, the rest was sold via pipeline. The US 12H and 13H wells are also connected to this gas sales pipeline. When estimating the potential to emit, it was conservatively assumed that 10% of the produced gas was flared. The flares have a 98% control efficiency. The use of the flares as air pollution control equipment is accounted for in the PTE because it is legally and practically enforceable. All produced gas from production and storage operations that is not sold must be sent to an emission control device with at least a 98% control efficiency for VOCs per the Federal Implementation Plan for Oil and Natural Gas Well Production Facilities Fort Berthold Indian Reservation (40 CFR §49.4164).

4.2 Estimated Actual Annual Emissions

To estimate the actual annual emissions the actual daily production average for each well was multiplied by 365 days to get the total estimated annual production for the facility in a year. The actual daily production average was based on the production data for each well as follows:

- the most recent 12 months of operation (September 2018 through August 2019) of production for the PetroShale US 8H well;
- the first 39 days (end of August 2019 through the first of October 2019) of production for the PetroShale US 12H well; and
- the first 4 months (May 2019 through August 2019) of production for the PetroShale US 13H well.

The production rates for each well were combined to estimate the production emissions for the entire facility with all three wells operating. The PetroShale US 8H well was connected to a gas sales pipeline on May 11, 2018 and in the most recent 12 months of production, approximately 8.4% of the produced gas was flared, the rest was sold via pipeline. The US 12H and 13H wells are also connected to this gas sales pipeline. When estimating the actual annual emissions, it was assumed that the 12H and 13H wells would flare the same percentage of produced gas as the US 8H well flared for the past 12 months.

4.3 Emission Units

The PTE and the estimated actual annual emissions for the Primus Facility are estimated according to the following methodology for each emission unit type.

4.3.1 Crude Oil/Condensate Storage Tanks

To calculate the working, breathing, standing, and flashing losses from the eight (8) 400-barrel crude oil/condensate storage tanks and the eight (8) 1,000-barrel crude oil/condensate storage tanks, E&P TANK V2.0 was used. Inputs into the model include a representative oil and gas analysis and site-specific information. All tanks were modeled as one storage tank receiving all the produced oil from the wells. The crude oil/condensate storage tank emissions are controlled by four flares with a 98% destruction efficiency. Detailed inputs and outputs of the model are included in Appendix C.

4.3.2 Produced Water Tanks

To calculate the working, breathing, standing, and flashing losses from the four (4) 400-barrel produced water storage tanks and the four (4) 1,000-barrel produced water storage tanks, EPA Tanks 4.0.9d was used. Site-specific information was input into the model. One 400-bbl tank was modeled receiving one-fourth of all the produced water from the PetroShale US 8H well. One 1,000-bbl tank was modeled receiving one-fourth of all the produced water from the PetroShale US 12H and 13H wells. The emissions from these tank model runs were then each multiplied by four. The produced water storage tank emissions are controlled by four flares with a 98% destruction efficiency. Detailed inputs and outputs of the model are included in Appendix C.

4.3.3 Truck Loading

Loading losses from produced water truck loading were calculated using *AP-42 Section 5.2 – Transportation And Marketing Of Petroleum Liquids*. Loading losses were calculated using the following equation:

$$L_L = 12.46\frac{SPM}{(T + 460)}$$

Where L_L is the loading losses in pounds per 1,000 gallons of liquid loaded, S is the saturation factor for submerged loading (0.6), P is the true vapor pressure of the liquid loaded in psia (0.24 psia), M is the molecular weight of the vapors (20.7 lb/lb-mole), and T is the temperature of the bulk liquid loaded in degrees Fahrenheit (41.4 °F). All volatile organic compounds (VOCs) in the produced water are assumed to have been released to the atmosphere during truck loading.

4.3.4 Separators

There are three separators used onsite for separating the produced fluid stream into oil, natural gas, and produced water. The maximum fire box heat input rating for two of the separator heaters is 1,000,000 Btu/hr, each. The maximum fire box heat input rating for the remaining separator heater is 500,000 Btu/hr. The separator heaters are fueled by produced gas which has a gross heating value of 1,535.4 Btu/scf. Any excess produced gas not sold via gas sales line is flared. There are no supplemental fuel sources. Due to design operational limits, the separator burners must be functioning while the facility is in operation. Combustion emissions from the burner used to heat the fluid stream are vented to the atmosphere.

Emissions are calculated based on the assumption that the separators will operate 8,760 hours per year. PTE and estimated actual annual emissions are based on the maximum fuel consumption of the separator heaters. Particulate matter, NO_X, VOC, HAP, SO_2 and CO emissions have been calculated using emission factors obtained from *AP-42, Section 1.4 – Natural Gas Combustion, July 1998* for natural gas-fired external combustion sources. Appendix B includes detailed equations.

4.3.5 Fugitive Leaks

Fugitive emissions are calculated based on the number of sources of fugitive leaks (valves, pump seals, connectors, flanges, open-ended lines, etc.) and the composition of the flashed gas from the crude oil/condensate storage tanks as calculated by E&P TANK V2.0. The number of components at the site that could be sources of fugitive leaks was estimated was based on actual counts from a similar facility. Emission factors for the fugitive leaks were based on the *US EPA Protocol for Equipment Leak Emission Estimates* (EPA-453/R-95-017) for light oil. The emission calculations for fugitive leaks are presented in Appendix B.

4.3.6 Flares

Emissions from the storage tanks are vented to four Steffes-engineered flares with a 98% control efficiency. Any produced gas not used for fueling the separators or the flare pilot lights that wasn't able to be sold via pipeline is also sent to the flare system. The pilot lights for the flares are fueled by produced gas which has a gross heating value of 1,535.4 Btu/scf. It is assumed that the pilot lights will burn continuously (8,760 hours per year) and that combustion emissions from each flare's pilot light are vented to the atmosphere.

Particulate matter, SO_2, and VOC emissions from the flare's pilot light have been calculated using emission factors obtained from *AP-42, Section 1.4 – Natural Gas Combustion*, July 1998 for natural gas-fired external combustion sources. NO_X and CO emission factors are from *AP-42 Section 13.5 – Industrial Flares* to provide a more conservative estimate than the emission factors for NO_X and CO contained in AP-42 Section 1.4. Appendix B includes detailed equations.

4.3.7 Engines

The Primus Facility: PetroShale US 8H, US 12H, and US 13H facility uses an 215-hp Caterpillar 3406NA engine and a 400-hp Caterpillar 3408TA engine. The engines are fueled by natural gas and are certified to meet the emission standards of New Source Performance Standards Subpart JJJJ: Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.

Emissions of CO, NO_X, VOC, and CO_2 have been calculated based on the manufacturer's specifications. It was assumed that $PM_{2.5}$ was equivalent to PM_{10} which was assumed to be equivalent to PM. For SO_2, CO_2, and HAPs, emission factors for a 4-stroke rich burn industrial engine from *AP-42, Section 3.2 – Natural Gas-Fired Reciprocating Engines* were used. A conservative estimate of the uncontrolled potential SO_2 emissions, using an emission factor based on the short-term (hourly) SO_2 emissions for natural gas (2,000 grains sulfur per million standard cubic feet of natural gas [gr S/10^6 scf NG]), is 0.00058 pound per million British thermal units (lb/MMBtu) (40 CFR 72.2). GHG emissions are calculated using emission factors provided from 40 CFR 98 Subpart C, Tables C-1 and C-2, for the combustion of natural gas.

Potential emissions are calculated based on the assumption that the engines will operate 8,760 hours per year. Maximum hourly emissions are calculated by multiplying the nominal bhp rating or the natural gas consumption rate of each engine and hours of operation per year by the appropriate emission factors. Appendix B provides the detailed emissions estimates with example calculations. The vendor-supplied engine certificates are included in Appendix C.

5 EMISSION SUMMARY

The PTE and the estimated actual annual emissions for the facility are presented below. Detailed emission calculations are provided in Appendix B.

5.1 Potential to Emit

The PTE calculated based is presented in Table 4.

Table 4. Potential to Emit in Tons per Year

Emission Source Category	VOC	HAPs	NO_X	CO	SO_2	PM_{10}	H_2S
(3) 2-Phase Separators w/Heater Treaters	0.06	0.02	1.07	0.90	0.01	0.08	-
(16) Crude Oil/Condensate Storage Tanks	83.10	1.29	7.23	32.94	0.06	0.79	0.00
(8) Produced Water Storage Tanks	0.01	< 0.01	-	-	-	-	0.00
(4) Flare Pilots	< 0.01	< 0.01	0.02	0.09	< 0.01	< 0.01	-
Fugitive Leaks	6.61	0.34	-	-	-	-	0.00
Truck Loading	0.37	0.01	-	-	-	-	0.00
(2) Engines	4.16	0.70	5.94	11.88	0.01	0.21	-
Produced Gas	31.86	0.78	6.19	28.24	0.05	0.68	0.00
Total PTE	**126.16**	**3.14**	**20.45**	**74.05**	**0.13**	**1.76**	**0.00**
Minor NSR Threshold	5	-	10	10	10	5	2
Above Minor NSR Threshold?	**Yes**	**N/A**	**Yes**	**Yes**	**No**	**No**	**No**
Title V Major Source Threshold	100	25	100	100	100	100	-
Above Title V Major Source Threshold?	**Yes**	**No**	**No**	**No**	**No**	**No**	**N/A**
Major NSR Threshold	250	-	250	250	250	250	-
Above Major NSR Threshold?	**No**	**N/A**	**No**	**No**	**No**	**No**	**N/A**

Note: $PM_{2.5}$ is assumed to be equal to PM_{10}.

The PTE for the entire is above the Title V major source threshold for VOC but below for the other pollutants. The PTE for the facility is above the minor NSR threshold for VOC, NO_X, and CO. The Primus facility must register with the EPA per the Federal Indian Country Minor NSR Rule.

5.2 Estimated Actual Annual Emissions

The estimated actual annual emissions for the Primus Facility are presented in Table 5.

Table 5. Estimated Actual Annual Emissions in Tons per Year

Emission Source Category	VOC	HAPs	NO_X	CO	SO_2	PM_{10}	H_2S
(3) 2-Phase Separators w/Heater Treaters	0.06	0.02	1.07	0.90	0.01	0.08	-
(16) Crude Oil/Condensate Storage Tanks	53.70	0.84	4.67	21.29	0.04	0.51	0.00
(8) Produced Water Storage Tanks	0.01	< 0.01	-	-	-	-	0.00
(4) Flare Pilots	< 0.01	< 0.01	0.02	0.09	< 0.01	< 0.01	-
Fugitive Leaks	6.61	0.34	-	-	-	-	0.00

Emission Source Category	VOC	HAPs	NO_X	CO	SO_2	PM_{10}	H_2S
Truck Loading	0.25	< 0.01	-	-	-	-	0.00
(2) Engines	4.16	0.70	5.94	11.88	0.01	0.21	-
Produced Gas	15.90	0.39	3.09	14.09	0.03	0.34	0.00
Total Actual Emissions	**80.68**	**2.29**	**14.79**	**48.25**	**0.09**	**1.14**	**0.00**
Minor NSR Threshold	5	-	10	10	10	5	2
Above Minor NSR Threshold?	**Yes**	**N/A**	**Yes**	**Yes**	**No**	**No**	**No**
Title V Major Source Threshold	100	25	100	100	100	100	-
Above Title V Major Source Threshold?	**No**	**No**	**No**	**No**	**No**	**No**	**N/A**
Major NSR Threshold	250	-	250	250	250	250	-
Above Major NSR Threshold?	**No**	**N/A**	**No**	**No**	**No**	**No**	**N/A**

Note: $PM_{2.5}$ is assumed to be equal to PM_{10}.

The estimated actual annual emissions for the facility were greater than minor NSR thresholds (for VOC, NO_X, and CO) and, therefore, the facility must register with the EPA. The estimated actual annual emissions are less than major NSR thresholds and Title V major source thresholds.

6 FIP FOR OIL AND NATURAL GAS WELL PRODUCTION FACILITIES – FORT BERTHOLD INDIAN RESERVATION

The FIP is used instead of source-specific minor NSR preconstruction permits in Indian country. It incorporates emissions limits and other requirements from eight federal standards, applying limits for a range of equipment and processes used in oil and natural gas production and natural gas processing. Table 6 identifies those requirements and notes whether the requirement is applicable or not.

Table 6. Requirements Referenced in the FIP for True Minor Sources in Indian Country in the Oil and Natural Gas Industry Applicability Determination

Citation	Title	Potentially-Affected Facility Source(s)	Discussion	Applicability
40 CFR Part 60, Subpart OOOOa	Standards for New and Modified Sources in the Oil and Natural Gas Sector	The Facility: Primus Facility: PetroShale US 8H, US 12H, and US 13H, Storage Tanks, Fugitive Emissions, and Hydraulically-Fractured Oil and Gas Well Completions	The facility is a well-affected facility under this subpart and is subject to the subpart requirements. The well completions at the facility are subject to the requirements of this subpart. The produced water storage tanks are exempt from the requirements of this subpart because the PTE of the tanks is less than 1 tpy of VOC. The PTE of the crude oil/condensate storage tanks is 82.53 tpy (5.19 tpy per tank). Because the crude oil/condensate storage tanks have a PTE of less than 6 tpy per storage tank, they are exempt from the requirements of this subpart. Fugitive sources of emissions are subject to LDAR fugitive leak monitoring requirements amongst others.	Yes
40 CFR Part 60, Subpart Kb	Performance Standards for VOC Liquid Storage Tanks	Storage Tanks ($\geq 75\ m^3$)	The eight 1,000-bbl crude oil storage tanks at the facility are greater than 75 m^3 (approx. 472 bbl). Therefore, these storage tanks are subject to the requirements of this subpart.	Yes
40 CFR Part 60, Subpart IIII	Performance Standards for Stationary Compression Ignition Internal Combustion Engines	None	There are no stationary compression ignition internal combustion engines at the facility.	No
40 CFR Part 60, Subpart JJJJ	Performance Standards for Stationary Spark Ignition Internal Combustion Engines	Engines	The engines at this facility are less than 500 hp and was manufactured after July 1, 2008 and is subject to the subpart requirements. The engines have been certified by the manufacturer to meet the emission standards of this subpart for non-emergency natural gas engines.	Yes
40 CFR Part 60, Subpart KKKK	Performance Standards for New Stationary Combustion Turbines	None	There are no stationary combustion turbines at the facility.	No
40 CFR Part 63, Subpart DDDDD	Air Toxics Standards for Industrial, Commercial, and Institutional Boilers and Process Heaters	Separator Heaters	The facility does not meet the subpart's definition of an affected source because it is not a major source of HAPs as defined in the subpart (the emissions from three wells at the facility are not to be combined when making the major source determination). Thus, the heaters are not subject to the requirements of this subpart.	No

Citation	Title	Potentially-Affected Facility Source(s)	Discussion	Applicability
40 CFR Part 63, Subpart HH	Air Toxics Standards for Oil and Natural Gas Production Facilities	The Facility: Primus Facility: PetroShale US 8H, US 12H, and US 13H	Primus Facility: PetroShale US 8H, US 12H, and US 13H well pad does not meet the definition of an affected facility under the referenced requirement because there are no tri-ethylene glycol dehydration units located at the facility. Therefore, the facility is not subject to the requirements of this subpart.	No
40 CFR Part 63, Subpart ZZZZ	Air Toxics Standards for Stationary Reciprocating Internal Combustion Engines	Engines	The stationary reciprocating internal combustion engine at the facility meets the requirements of subpart ZZZZ by meeting those of subpart JJJJ discussed above.	Yes

A summary of the requirements for the FIP for oil and gas well production facilities at Fort Berthold Indian Reservation is provided in Table 7.

Table 7. Review of FIP for Oil & Gas Facilities in Fort Berthold Reservation

Citation	Title	Applicability	Requirements	Compliance
40 CFR §49.4164	Construction and Operational Control Measures	Yes	Gas produced during well (re)completion must be routed to a control device with a destruction efficiency (DRE) of at least 90%. Any gas emissions due to production or storage operations must be routed to a control device with a DRE of at least 90%. Within 90 days from the first date of production, the facility must send the produced gas and any gas emissions from the storage tanks via a closed-vent system to either a gas sales line or to a control device with a DRE of at least 98%.	PetroShale sends produced gas to a sales line except during upset conditions. The storage tank emissions are sent via a closed-vent system to the Steffes-engineered flares with a DRE of 98%.
40 CFR §49.4165	Control Equipment Requirements	Yes	Covers – every oil or water storage tank must have a cover that forms an impermeable barrier over the covered surface area. The cover should always be sealed shut except to add or remove material from the storage tank, inspect or sample the contained material, or for maintenance or inspections of equipment within the storage tank. Closed Vent Systems – closed vent systems must always be operated properly and operate without detecting gas emissions. If the system has a bypass device, the bypass device must either have a continuously-reading natural gas flow indicator with an alarm, or else use a lock and key configuration to secure the bypass valve at the inlet to the bypass device. Enclosed Combustors and Utility Flares – a flare must be operated per manufacturer specifications. The flare must be able to reduce gas VOC emissions by at least 98%. The flare must have a liquid knock-out system, a flash-back flame arrestor, either a continuously burning pilot flame with thermocouple or similar device, or an electronic automatic igniter, and a continuous monitoring system. The flare must be not be leaking or have any visible smoke emissions as determined by EPA Method 22. The flare must either: a) have a diameter of 3" or greater, is non-assisted, has a hydrogen content of 8% by volume or more, and is designed and operated with an exit velocity less than 122 ft/s and less than V_{max}. or b) if the flare is unassisted, it must only be used with a net heating value for the combusted gas at 200 Btu/scf or greater; if the flare is steam- or air-assisted it must only be used when the net heating value of the combusted gas is 300 Btu/scf or greater and the maximum tip velocity (as determined in §60.18(c)(4) *Pit Flares* – pit flares that have no visible emissions and have an automatic igniter may be operated to reduce natural gas VOCs by at least 90%. An operating manual must be written specifically for the pit flare and facility. The pit flare may only be used to: a) control gas emissions during well (re)completion operations, or b) to control oil or water storage tank emissions provided that the total VOC for all storage tanks at the facility is less than 20 tons per 12-month period, or c) to control gas emissions that were diverted from pipeline injection to a backup control device temporarily (max. 500 hours). *Other Control Devices* – besides the control devices above, other control devices may be used with prior approval from the EPA as long as the device has a DRE of at least 98% for VOCs.	The covers on the storage tanks at the Primus Facility: PetroShale US 8H, US 12H, and US 13H facility will be impermeable and used as required. The closed vent system will be operated properly. The Steffes-engineered flares have all required features, will be operated per manufacturer specifications, and have a DRE of 98% as required.

Citation	Title	Applicability	Requirements	Compliance
40 CFR §49.4166	Monitoring Requirements	Yes	Oil and gas production facilities at Fort Berthold Reservation will monitor the following, if applicable: • barrels of oil produced each time oil is unloaded from the storage tanks, • the operating hours of the pit flare, • the volume of produced natural gas sent to the enclosed combustor, utility flare, and/or pit flare, and • the volume of gas for all oil and produced water storage tanks that is sent to the enclosed combustor, utility flare, and/or pit flare. The following require quarterly visual inspections that must be done while the storage tanks are filling: 1) Tank hatches, covers, seals, pressure release valves, and closed vent systems. 2) Valves in the closed vent system and storage tank control system. Enclosed combustors, utility flares, and pit flares: • Must be physically inspected each time an operator is on site (minimum quarterly). • Must continuously monitor operational parameters that vary using malfunction alarms and remote notification systems where available. • Must monitor for visible smoke during operation each time an operator is on site (minimum quarterly). • Address any failures of the continuously burning pilot flame, automatic igniter, or improper operation of monitoring equipment.	PetroShale will monitor produced oil and volume of gas sent to flares. Quarterly visual inspections while the tanks are filling will be conducted as required. PetroShale will inspect and monitor the flares as required.

Citation	Title	Applicability	Requirements	Compliance
40 CFR §49.4167	Recordkeeping Requirements	Yes	Below is a list of records the facility is required to keep: • Oil production (barrels); • Produced gas volume sent to combustor; • Volume of natural gas sent to the combustor from the storage tanks; • Well (re)completion data, including the lat/lon of the well, the date, time, & duration (hours) of flowback from the well, the date, time, & duration (hours) of casinghead gas venting, and reasons for venting the gas instead of capturing or combusting; • For each combustor/utility flare/pit flare record: operating manual, operation monitoring, deviation data (deviation operating time, date, time, length of time of deviation, corrective actions, preventative measures), records of missing pilot flame, malfunctioning automatic igniter, malfunctioning monitoring equipment, date & time of occurrence, action taken, preventative measures adopted; recording data device failure, time periods that saw visible smoke emissions from the combustor/utility flare, or pit flare; • For the pit flare: a log of times pit flare was operational because gas that was to be injected into pipeline was diverted. The log must note date & time of flare start-up and shut-down, hours of operation due to infeasible pipeline injection from the previous 11 months thru now, and justification for each operation event; • Records of closed-vent system bypass or shutdown, reason, duration, volume of gas released, action taken, and preventative measures adopted; and • Produced water tanks and oil tanks inspection (as required by §49.4166) records, including date, findings, adjustments/repairs, name & signature of inspector. The above records must be kept at the facility or at the location of that operates the facility on a daily basis. These records must be retained for 5 years from the date of record.	PetroShale will keep the records required for each piece of applicable equipment.
40 CFR §49.4168	Notification and Reporting Requirements	Yes	An annual report is due on 8/15 each year must cover all information for the previous year. The initial report must cover all information for that year. The annual report must contain: company name and address of oil and gas facility, identification of the production facility, reporting period beginning & ending dates, summary of all required records for each well (re)completion operation that occurred within the reporting period, first date of production for each well that began operating during the reporting period, summary of instances where well construction or operation was not in compliance with §49.4164, §49.4165, or §49.4166 for all wells at a facility, and certification of truth, accuracy, & completeness.	PetroShale will submit the required annual report with all required data by 8/15 each year.

APPENDIX A

Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources Part 2 **Form**

United States Environmental Protection Agency
https://www.epa.gov/tribal-air/tribal-minor-new-source-review
January 4, 2017

Part 2: Submit Within 60 Days After Startup of Production -- Emission and Production Information

FEDERAL IMPLEMENTATION PLAN FOR TRUE MINOR SOURCES IN INDIAN COUNTRY IN THE OIL AND NATURAL GAS PRODUCTION AND NATURAL GAS PROCESSING SEGMENTS OF THE OIL AND NATURAL GAS SECTOR

Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources

Please submit information to:

[Reviewing Authority Address Phone]	Air Program (Mail Code 8P-AR) US EPA Region 8 1595 Wynkoop St. Denver, CO 80202

A. GENERAL SOURCE INFORMATION (See Instructions Below)

1. Company Name Petroshale (US), Inc.		**2. Source Name** Primus Facility: PetroShale US 8H, US 12H, and US 13H Oil & Gas Production Facility	
3. Type of Oil and Natural Gas Operation Crude petroleum and natural gas extraction		**4. New Minor Source?** ☐ Yes ☒ No **5. True Source Modification?** ☒ Yes ☐ No	
6. NAICS Code 211111		**7. SIC Code** 1311	
8. U.S. Well ID(s) or API Number(s) [if applicable] 33-053-07650, 33-053-07780, 33-053-07868			
9. Area of Indian Country Fort Berthold	**10. County** McKenzie	**11a. Latitude** 47.991647	**11b. Longitude** -102.740876

B. CONTACT INFORMATION (See Instructions Below)

1. Owner Name	Title
Petroshale (US), Inc. - Tony Izzo	Vice President - Engineering & Business Development
Mailing Address 303 East 17th Avenue, Suite 940 Denver, CO 80203	
Email Address izzo@petroshaleinc.com	
Telephone Number (403) 513-0107	Facsimile Number (303) 484-3255
2. Operator Name (if different from owner) N/A	Title Same as Owner
Mailing Address	
Email Address	
Telephone Number	Facsimile Number
3. Source Contact Lauren Morahan	Title Manager - Regulatory & Compliance
Mailing Address 303 East 17th Avenue, Suite 940 Denver, CO 80203	
Email Address morahan@petroshaleinc.com	
Telephone Number (720) 343-8142	Facsimile Number (303) 484-3255

4. Compliance Contact Same as Source Contact	Title
Mailing Address Same as Source Contact	
Email Address Same as Source Contact	
Telephone Number Same as Source Contact	Facsimile Number

C. EMISSIONS AND OTHER SOURCE INFORMATION

Include all of the following information in the table below and as attachments to this form:

Note: The emission estimates can be based upon actual test data or, in the absence of such data, upon procedures acceptable to the Reviewing Authority. The following procedures are generally acceptable for estimating emissions from air pollution sources: (1) unit-specific emission tests; (2) mass balance calculations; (3) published, verifiable emission factors that are applicable to the unit (i.e., manufacturer specifications); (4) other engineering calculations; or (5) other procedures to estimate emissions specifically approved by the Reviewing Authority. Guidance for estimating emissions can be found at https://www.epa.gov/chief.

- ☒ Narrative description of the operations.
- ☒ Identification and description of any air pollution control equipment and compliance monitoring devices or activities.
- ☒ Type and actual amount (annually) of each fuel that will be used.
- ☒ Type of raw materials used (e.g., water for hydraulic fracturing).
- ☒ Actual, annual production rates.
- ☒ Actual operating schedules.
- ☒ Any existing limitations on source operations affecting emissions or any work practice standards, where applicable, for all regulated New Source Review (NSR) pollutants at your source. Indicate all requirements referenced in the Federal Implementation Plan (FIP) for True Minor Sources in Indian Country in the Oil and Natural Gas Production and Natural Gas Processing Segments of the Oil and Natural Gas Sector that apply to emissions units and air pollution generating activities at the source or proposed. Include statements indicating each emissions unit that is an emissions unit potentially subject to the requirements referenced in the FIP, but does not meet the definition of an affected facility under the referenced requirement, and therefore, is not subject to those requirements.
- ☒ For each emissions unit comprising the new source or modification, estimates of the total allowable (potential to emit) annual emissions at startup of production from the air pollution source for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides ( ), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Allowable annual emissions are defined as: emissions rate of an emissions unit calculated using the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical

or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation, or the effect it would have on emissions, is legally and practically enforceable. You must determine the potential for emissions within 30 days from the startup of production.

▣ For each emissions unit comprising the new source or modification, estimates of the total actual annual emissions during the upcoming, consecutive 12 months from the air pollution source for the following air pollutants: particulate matter (PM, PM_{10}, $PM_{2.5}$), sulfur oxides (SO_x), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, ammonia (NH_3), fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Estimates of actual emissions must take into account equipment, operating conditions, and air pollution control measures. You should calculate an estimate of the actual annual emissions using estimated operating hours, production rates, in-place control equipment, and types of materials processed, stored, or combusted.

D. TABLE OF ESTIMATED EMISSIONS

Provide in the table below estimates of the total allowable annual emissions in tons per year (tpy) and total actual annual emissions (tpy) for the following pollutants for all emissions units comprising the new source or modification.

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
PM	1.76	1.14
PM_{10}	1.76	1.14
$PM_{2.5}$	1.76	1.14
SO_x	0.13	0.09
NO_x	20.45	14.79
CO	74.05	48.25
VOC	126.16	80.68
Pb	0.00	0.00

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
NH3	0.00	0.00
Fluorides		
H_2SO_4	0.00	0.00
H_2S	0.00	0.00
TRS	0.00	0.00

APPENDIX B

Emission Calculations

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Emission Sources

Table B.1. - Emission Sources

Emission Unit	Quantity	Rating/Capacity
2-Phase Separators w/Heater Treater	2	1.0 MMBtu/hr each
2-Phase Separators w/Heater Treater	1	0.5 MMBtu/hr
Crude Oil/Condensate Storage Tanks	8	400 BBL each
Crude Oil/Condensate Storage Tanks	8	1,000 BBL each
Produced Water Storage Tanks	4	400 BBL each
Produced Water Storage Tanks	4	1,000 BBL each
Flares	4	21.45 scf/hr pilot rating
Fugitive Leaks	-	-
Truck Loading	-	N/A
Compressor Engine	1	400 horsepower
Compressor Engine	1	215 horsepower
Produced Gas	-	-

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Emissions Summaries

Table B.2. - Summary of Uncontrolled Emissions in Pounds per Hour

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.01	0.00	0.25	0.21	0.00	-	0.02	0.02	292.75
(16) Crude Oil/Condensate Storage Tanks	942.15	12.52	-	-	-	0.00	-	-	169.69
(8) Produced Water Storage Tanks	0.07	0.00	-	-	-	0.00	-	-	0.01
(4) Flares Pilots	-	-	-	-	-	-	-	-	-
Fugitive Leaks	1.51	0.08	-	-	-	0.00	-	-	0.19
Truck Loading	0.48	0.01	-	-	-	0.00	-	-	0.10
(2) Compressor Engines	0.23	0.16	36.41	2.07	0.00	-	0.05	0.05	576.06
Produced Gas	358.09	7.01	-	-	-	0.00	-	-	8,149.34
Total	**1,302.53**	**19.77**	**36.65**	**2.28**	**0.00**	**0.00**	**0.07**	**0.07**	**9,188.15**

Table B.3. - Summary of Uncontrolled Emissions in Tons Per Year

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.06	0.02	0.25	0.21	0.00	-	0.08	0.08	1,282.22
(16) Crude Oil/Condensate Storage Tanks	4,126.64	54.82	-	-	-	0.00	-	-	743.26
(8) Produced Water Storage Tanks	0.29	0.00	-	-	-	0.00	-	-	0.06
(4) Flares Pilots	-	-	-	-	-	-	-	-	-
Fugitive Leaks	6.61	0.34	-	-	-	0.00	-	-	0.85
Truck Loading	0.37	0.01	-	-	-	0.00	-	-	0.08
(2) Compressor Engines	0.99	0.70	159.47	9.09	0.01	-	0.21	0.21	2,523.16
Produced Gas	1,568.43	30.69	-	-	-	0.00	-	-	35,694.09
Total	**5,703.38**	**86.58**	**159.72**	**9.29**	**0.01**	**0.00**	**0.29**	**0.29**	**40,243.73**

Table B.4. - Summary of Controlled Emissions in Pounds per Hour

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.01	0.00	0.25	0.21	0.00	-	0.02	0.02	292.75
(16) Crude Oil/Condensate Storage Tanks	18.97	0.30	1.65	7.52	0.01	0.00	0.18	0.18	2,845.84
(8) Produced Water Storage Tanks	0.00	0.00	-	-	-	0.00	-	-	0.00
(4) Flares Pilots	0.00	0.00	0.00	0.02	0.00	-	0.00	0.00	7.91
Fugitive Leaks	1.51	0.08	-	-	-	0.00	-	-	0.19
Truck Loading	0.48	0.01	-	-	-	0.00	-	-	0.10
(2) Compressor Engines	0.95	0.16	1.36	2.71	0.00	-	0.05	0.05	677.45
Produced Gas	7.27	0.18	1.41	6.45	0.01	0.00	0.16	0.16	2,608.15
Total	**29.20**	**0.72**	**4.67**	**16.91**	**0.03**	**0.00**	**0.40**	**0.40**	**6,432.40**

Table B.5. - Summary of Controlled Emissions in Tons Per Year

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.06	0.02	1.07	0.90	0.01	-	0.08	0.08	1,282.22
(16) Crude Oil/Condensate Storage Tanks	83.10	1.29	7.23	32.94	0.06	0.00	0.79	0.79	12,464.79
(8) Produced Water Storage Tanks	0.01	0.00	-	-	-	0.00	-	-	0.02
(4) Flares Pilots	0.00	0.00	0.02	0.09	0.00	-	0.00	0.00	34.65
Fugitive Leaks	6.61	0.34	-	-	-	0.00	-	-	0.85
Truck Loading	0.37	0.01	-	-	-	0.00	-	-	0.08
(2) Compressor Engines	4.16	0.70	5.94	11.88	0.01	-	0.21	0.21	2,967.25
Produced Gas	31.86	0.78	6.19	28.24	0.05	0.00	0.68	0.68	11,423.68
Total	**126.16**	**3.14**	**20.45**	**74.05**	**0.13**	**0.00**	**1.76**	**1.76**	**28,173.54**

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
HAPs Emissions Summaries

Table B.6. - Summary of Uncontrolled HAP Emissions in Pounds per Hour

Hazardous Air Pollutant	Separators	Condensate Tanks	Produced Water Tanks	Flare Pilots	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	8.3E-05	**8.3E-05**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	5.0E-05	**5.0E-05**
1,3-Butadiene	-	-	-	-	-	-	-	2.2E-03	**2.2E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
2-Methylnaphthalene	5.9E-08	-	-	-	-	-	-	-	**5.9E-08**
2,2,4-Trimethylpentane	-	0.90	0.00	-	0.01	0.00	0.52	-	**1.43**
3-Methylchloranthrene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
7,12-Dimethylbenz(a)anthracene	3.9E-08	-	-	-	-	-	-	-	**3.9E-08**
Acenaphthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Acetaldehyde	-	-	-	-	-	-	-	9.2E-03	**9.2E-03**
Acrolein	-	-	-	-	-	-	-	8.7E-03	**8.7E-03**
Anthracene	5.9E-09	-	-	-	-	-	-	-	**5.9E-09**
Benzene	5.1E-06	1.10	6.6E-05	-	5.2E-03	6.0E-04	0.60	5.2E-03	**1.71**
Benzo(a)anthracene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(a)pyrene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Benzo(b)fluoranthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(k)fluoranthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(g,h,i)perylene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Carbon Tetrachloride	-	-	-	-	-	-	-	5.8E-05	**5.8E-05**
Chlorobenzene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
Chloroform	-	-	-	-	-	-	-	4.5E-05	**4.5E-05**
Chrysene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Dibenz(a,h)anthracene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Dichlorobenzene	2.9E-06	-	-	-	-	-	-	-	**2.9E-06**
Ethylbenzene	-	7.3E-02	4.4E-06	-	3.1E-03	3.0E-04	0.04	8.2E-05	**0.12**
Ethylene Dibromide	-	-	-	-	-	-	-	7.0E-05	**7.0E-05**
Fluoranthene	7.4E-09	-	-	-	-	-	-	-	**7.4E-09**
Fluorene	6.9E-09	-	-	-	-	-	-	-	**6.9E-09**
Formaldehyde	1.8E-04	-	-	-	-	-	-	6.74E-02	**6.76E-02**
n-Hexane	4.4E-03	9.58	5.7E-04	-	0.03	0.00	7.01	-	**16.62**
Indeno(1,2,3-cd)pyrene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Methanol	-	-	-	-	-	-	-	1.0E-02	**1.0E-02**
Methylene Chloride	-	-	-	-	-	-	-	1.4E-04	**1.4E-04**
Naphthalene	1.5E-06	-	-	-	-	-	-	3.2E-04	**3.2E-04**
PAH	-	-	-	-	-	-	-	4.6E-04	**4.6E-04**
Phenanathrene	4.2E-08	-	-	-	-	-	-	-	**4.2E-08**
Pyrene	1.2E-08	-	-	-	-	-	-	-	**1.2E-08**
Styrene	-	-	-	-	-	-	-	3.9E-05	**3.9E-05**
Toluene	8.3E-06	0.56	3.4E-05	-	6.9E-03	4.0E-05	3.05	1.8E-03	**3.62**
Vinyl Chloride	-	-	-	-	-	-	-	2.4E-05	**2.4E-05**
Xylene	-	0.30	1.8E-05	-	2.2E-02	5.3E-03	0.16	6.4E-04	**0.49**
Total	**4.61E-03**	**12.52**	**7.51E-04**	**0.00**	**0.08**	**0.01**	**11.38**	**0.11**	***24.09***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
HAPs Emissions Summaries

Table B.7. - Summary of Controlled HAP Emissions in Pounds per Hour

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	8.3E-05	**8.3E-05**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	5.0E-05	**5.0E-05**
1,3-Butadiene	-	-	-	-	-	-	-	2.2E-03	**2.2E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
2-Methylnaphthalene	5.9E-08	-	-	1.6E-09	-	-	-	-	**6.0E-08**
2,2,4-Trimethylpentane	-	0.02	0.00	-	0.01	0.00	0.01	-	**0.04**
3-Methylchloranthrene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
7,12-Dimethylbenz(a)anthracene	3.9E-08	-	-	1.1E-09	-	-	-	-	**4.0E-08**
Acenaphthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Acetaldehyde	-	-	-	-	-	-	-	9.2E-03	**9.2E-03**
Acrolein	-	-	-	-	-	-	-	8.7E-03	**8.7E-03**
Anthracene	5.9E-09	-	-	1.6E-10	-	-	-	-	**6.0E-09**
Benzene	5.1E-06	2.2E-02	1.3E-06	1.4E-07	5.2E-03	6.0E-04	0.01	5.2E-03	**0.05**
Benzo(a)anthracene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(b)fluoranthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(k)fluoranthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(a)pyrene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Benzo(g,h,l)perylene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Carbon Tetrachloride	-	-	-	-	-	-	-	5.8E-05	**5.8E-05**
Chlorobenzene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
Chloroform	-	-	-	-	-	-	-	4.5E-05	**4.5E-05**
Chrysene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Dibenz(a,h)anthracene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Dichlorobenzene	2.9E-06	-	-	7.9E-08	-	-	-	-	**3.0E-06**
Ethylbenzene	-	1.5E-03	8.8E-08	-	3.1E-03	3.0E-04	8.1E-04	8.2E-05	**5.8E-03**
Ethylene Dibromide	-	-	-	-	-	-	-	7.0E-05	**7.0E-05**
Fluoranthene	7.4E-09	-	-	2.0E-10	-	-	-	-	**7.6E-09**
Fluorene	6.9E-09	-	-	1.9E-10	-	-	-	-	**7.0E-09**
Formaldehyde	1.8E-04	-	-	5.0E-06	-	-	-	6.74E-02	**6.76E-02**
n-Hexane	4.4E-03	0.23	1.1E-05	1.2E-04	0.03	0.00	0.18	-	**0.45**
Indeno(1,2,3-cd)pyrene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Methanol	-	-	-	-	-	-	-	1.0E-02	**1.0E-02**
Methylene Chloride	-	-	-	-	-	-	-	1.4E-04	**1.4E-04**
Naphthalene	1.5E-06	-	-	4.0E-08	-	-	-	3.2E-04	**3.2E-04**
PAH	-	-	-	-	-	-	-	4.6E-04	**4.6E-04**
Phenanathrene	4.2E-08	-	-	1.1E-09	-	-	-	-	**4.3E-08**
Pyrene	1.2E-08	-	-	3.3E-10	-	-	-	-	**1.3E-08**
Styrene	-	-	-	-	-	-	-	3.9E-05	**3.9E-05**
Toluene	8.3E-06	1.1E-02	6.7E-07	2.3E-07	6.9E-03	4.0E-05	0.06	1.8E-03	**0.08**
Vinyl Chloride	-	-	-	-	-	-	-	2.4E-05	**2.4E-05**
Xylene	-	6.0E-03	3.6E-07	-	2.2E-02	5.3E-03	0.00	6.4E-04	**0.04**
Total	**4.61E-03**	**0.29**	**1.50E-05**	**1.25E-04**	**0.08**	**0.01**	**0.26**	**0.11**	***0.75***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
HAPs Emissions Summaries

Table B.8. - Summary of Uncontrolled HAP Emissions in Tons per Year

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	3.6E-04	**3.6E-04**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	2.2E-04	**2.2E-04**
1,3-Butadiene	-	-	-	-	-	-	-	9.6E-03	**9.6E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	1.8E-04	**1.8E-04**
2-Methylnaphthalene	2.6E-07	-	-	-	-	-	-	-	**2.6E-07**
2,2,4-Trimethylpentane	-	3.96	0.00	-	0.04	0.00	2.28	-	**6.27**
3-Methylchloranthrene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
7,12-Dimethylbenz(a)anthracene	1.7E-07	-	-	-	-	-	-	-	**1.7E-07**
Acenaphthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Acetaldehyde	-	-	-	-	-	-	-	0.04	**0.04**
Acrolein	-	-	-	-	-	-	-	3.8E-02	**3.8E-02**
Anthracene	2.6E-08	-	-	-	-	-	-	-	**2.6E-08**
Benzene	2.3E-05	4.83	2.9E-04	-	2.3E-02	4.6E-04	2.63	2.3E-02	**7.50**
Benzo(a)anthracene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(b)fluoranthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(k)fluoranthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(a)pyrene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Benzo(g,h,l)perylene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Carbon Tetrachloride	-	-	-	-	-	-	-	2.6E-04	**2.6E-04**
Chlorobenzene	-	-	-	-	-	-	-	1.9E-04	**1.9E-04**
Chloroform	-	-	-	-	-	-	-	2.0E-04	**2.0E-04**
Chrysene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Dibenz(a,h)anthracene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Dichlorobenzene	1.3E-05	-	-	-	-	-	-	-	**1.3E-05**
Ethylbenzene	-	3.2E-01	1.9E-05	-	1.4E-02	2.4E-04	0.18	3.6E-04	**0.51**
Ethylene Dibromide	-	-	-	-	-	-	-	3.1E-04	**3.1E-04**
Fluoranthene	3.2E-08	-	-	-	-	-	-	-	**3.2E-08**
Fluorene	3.0E-08	-	-	-	-	-	-	-	**3.0E-08**
Formaldehyde	8.1E-04	-	-	-	-	-	-	0.30	**0.30**
n-Hexane	0.02	41.94	2.5E-03	-	0.14	0.00	30.69	-	**72.79**
Indeno(1,2,3-cd)pyrene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Methanol	-	-	-	-	-	-	-	4.4E-02	**4.4E-02**
Methylene Chloride	-	-	-	-	-	-	-	5.9E-04	**5.9E-04**
Naphthalene	6.5E-06	-	-	-	-	-	-	1.4E-03	**1.4E-03**
PAH	-	-	-	-	-	-	-	2.0E-03	**2.0E-03**
Phenanathrene	1.8E-07	-	-	-	-	-	-	-	**1.8E-07**
Pyrene	5.4E-08	-	-	-	-	-	-	-	**5.4E-08**
Styrene	-	-	-	-	-	-	-	1.7E-04	**1.7E-04**
Toluene	3.7E-05	2.45	1.5E-04	-	3.0E-02	3.1E-05	13.37	8.0E-03	**15.85**
Vinyl Chloride	-	-	-	-	-	-	-	1.0E-04	**1.0E-04**
Xylene	-	1.32	7.9E-05	-	9.7E-02	4.2E-03	0.69	2.8E-03	**2.12**
Total	**0.02**	**54.82**	**3.29E-03**	**0.00**	**0.34**	**0.01**	**49.83**	**0.47**	***105.48***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
HAPs Emissions Summaries

Table B.9. - Summary of Controlled HAP Emissions in Tons per Year

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	3.6E-04	**3.6E-04**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	2.2E-04	**2.2E-04**
1,3-Butadiene	-	-	-	-	-	-	-	9.6E-03	**9.6E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	1.8E-04	**1.8E-04**
2-Methylnaphthalene	2.6E-07	-	-	7.0E-09	-	-	-	-	**2.6E-07**
2,2,4-Trimethylpentane	-	0.08	0.00	-	0.04	0.00	0.05	-	**0.16**
3-Methylchloranthrene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
7,12-Dimethylbenz(a)anthracene	1.7E-07	-	-	4.6E-09	-	-	-	-	**1.8E-07**
Acenaphthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Acetaldehyde	-	-	-	-	-	-	-	4.02E-02	**4.02E-02**
Acrolein	-	-	-	-	-	-	-	3.8E-02	**3.8E-02**
Anthracene	2.6E-08	-	-	7.0E-10	-	-	-	-	**2.6E-08**
Benzene	2.3E-05	9.7E-02	5.8E-06	6.1E-07	2.3E-02	4.6E-04	0.05	2.3E-02	**0.20**
Benzo(a)anthracene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(b)fluoranthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(k)fluoranthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(a)pyrene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Benzo(g,h,l)perylene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Carbon Tetrachloride	-	-	-	-	-	-	-	2.6E-04	**2.6E-04**
Chlorobenzene	-	-	-	-	-	-	-	1.9E-04	**1.9E-04**
Chloroform	-	-	-	-	-	-	-	2.0E-04	**2.0E-04**
Chrysene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Dibenz(a,h)anthracene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Dichlorobenzene	1.3E-05	-	-	3.5E-07	-	-	-	-	**1.3E-05**
Ethylbenzene	-	6.4E-03	3.9E-07	-	1.4E-02	2.4E-04	3.5E-03	3.6E-04	**2.4E-02**
Ethylene Dibromide	-	-	-	-	-	-	-	3.1E-04	**3.1E-04**
Fluoranthene	3.2E-08	-	-	8.7E-10	-	-	-	-	**3.3E-08**
Fluorene	3.0E-08	-	-	8.1E-10	-	-	-	-	**3.1E-08**
Formaldehyde	8.1E-04	-	-	2.2E-05	-	-	-	0.30	**0.30**
n-Hexane	0.02	1.03	5.0E-05	5.2E-04	0.14	0.00	0.77	-	**1.96**
Indeno(1,2,3-cd)pyrene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Methanol	-	-	-	-	-	-	-	4.4E-02	**4.4E-02**
Methylene Chloride	-	-	-	-	-	-	-	5.9E-04	**5.9E-04**
Naphthalene	6.5E-06	-	-	1.8E-07	-	-	-	1.4E-03	**1.4E-03**
PAH	-	-	-	-	-	-	-	2.0E-03	**2.0E-03**
Phenanathrene	1.8E-07	-	-	4.9E-09	-	-	-	-	**1.9E-07**
Pyrene	5.4E-08	-	-	1.5E-09	-	-	-	-	**5.5E-08**
Styrene	-	-	-	-	-	-	-	1.7E-04	**1.7E-04**
Toluene	3.7E-05	4.9E-02	2.9E-06	9.9E-07	3.0E-02	3.1E-05	0.27	8.0E-03	**0.36**
Vinyl Chloride	-	-	-	-	-	-	-	1.0E-04	**1.0E-04**
Xylene	-	2.6E-02	1.6E-06	-	9.7E-02	4.2E-03	0.01	2.8E-03	**0.14**
Total	**0.02**	**1.28**	**6.58E-05**	**5.46E-04**	**0.34**	**0.01**	**1.16**	**0.47**	***3.27***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Most Recent Production Data

Table B.10.a - PetroShale US8H First 34 Days Production Data

Month	Days On	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared, MCF
December 2016	3	3,421	2,926	4,373	4,373
January 2017	31	40,013	7,001	55,121	55,121
Daily Average		**1,277.47**	**291.97**	**1,749.82**	**1,749.82**
Adjusted Daily Average [1, 2]		**766.48**	**175.18**	**1,049.89**	**104.99**

Note: Due to availability of monthly data in lieu of daily data the daily production average is based on the first 34 days of production.

[1] Assuming a 40% decline in production for the first year of operation.

[2] As of May 11, 2018, the US8H well was connected to a gas sales pipeline. Per the most recent 12 months' production data, approximately 8.4% of the gas produced is flared due to upset conditions. The adjusted daily average estimates the PTE with the conservative assumption that 10% of the produced gas is flared.

Table B.10.b - PetroShale US12H First 30 Days of Operation Production Data

Month	Days On	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared, MCF
August 2019	8	10,044	3,235	12,743	1,043
September 2019	22	25,377	N/A	30,782	N/A
Daily Average		**1,180.70**	**404.38**	**1,450.83**	**130.38**
Adjusted Daily Average [1, 2]		**708.42**	**242.63**	**870.50**	**87.05**

[1] Assuming a 40% decline in production for the first year of operation.

[2] The PetroShale US12H and US13H wells are connected to a gas sales pipeline. The adjusted daily average estimates the PTE with the conservative assumption that 10% of the produced gas is flared.

Table B.10.c - PetroShale US 13H First 44 Days Production Data

Date	Days On	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared, MCF
June 2019	22	14,289	10,020	29,092	29,092
May 2019	22	28,139	15,655	68,482	64,284
Daily Average		**964.27**	**583.52**	**2,217.59**	**2,122.18**
Adjusted Daily Average [1, 2]		**578.56**	**350.11**	**1,330.55**	**133.06**

Note: Due to availability of monthly data in lieu of daily data the daily production average is based on the first 44 days of production.

[1] Assuming a 40% decline in production for the first year of operation.

[2] The PetroShale US12H and US13H wells are connected to a gas sales pipeline. The adjusted daily average estimates the PTE with the conservative assumption that 10% of the produced gas is flared.

Table B.10.d - Daily Average Production of the Entire Primus Facility (all 3 wells)

Well	Oil Produced Per Day, BBLs	Water Produced Per Day, BBLs	Gas Produced Per Day, MSCF	Gas Flared Per Day, MCF
PetroShale US8H	766.48	175.18	1,049.89	104.99
PetroShale US12H	708.42	242.63	870.50	87.05
PetroShale US13H	578.56	350.11	1,330.55	133.06
Total Facility Daily Average [1]	**2,053.47**	**767.92**	**3,250.95**	**325.09**

[1] Assuming a 40% decline in production for the first year of operation.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Separator Burners

Table B.11. - Separator Burner Information

Parameter	Value
Burner Rating (each), MMBtu/hr	1.00
Number of Separator Burners	2
Burner Rating (each), MMBtu/hr	0.50
Number of Separator Burners	1
HHV, Btu/scf	1,535.40
Total Fuel Consumption, Mscf/day	39.08

Note: Fuel HHV from gas analysis dated March 6, 2017. Fuel consumption calculated using:

$$\frac{Mscf}{day} = \left[Burner\ rating, \frac{MMBtu}{hr}\right] \times \left[\frac{10^6 Btu}{MMBtu}\right] \times \left[\frac{24hr}{day}\right] \div \left[HHV, \frac{\mathrm{Btu}}{\mathrm{scf}}\right] \div \left[\frac{1{,}000\ scf}{Mscf}\right]$$

Table B.12. - Separator Burner Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
PM_{10} [1]	7.60	7.45E-03	0.02	0.08
$PM_{2.5}$ [1]	7.60	7.45E-03	0.02	0.08
SO_2	0.60	5.88E-04	1.47E-03	6.44E-03
NO_X	100.00	0.10	0.25	1.07
CO	84.00	0.08	0.21	0.90
VOC	5.50	5.39E-03	0.01	0.06

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Tables 1.4-1 and 1.4-2). Emission factors converted from lb/10^6 scf to lb/MMBtu by dividing by the average heat value of natural gas: 1,020 Btu/scf.

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.13. - Separator Burner Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	2.35E-08	5.88E-08	2.58E-07
3-Methylchloranthrene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.57E-08	3.92E-08	1.72E-07
Acenaphthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Anthracene	2.40E-06	2.35E-09	5.88E-09	2.58E-08
Benz(a)anthracene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Benzene	2.10E-03	2.06E-06	5.15E-06	2.25E-05
Benzo(a)pyrene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Benzo(b)fluoranthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Benzo(g,h,i)perylene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Benzo(k)fluoranthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Crysene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Dibenzo(a,h)anthracene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Dichlorobenzene	1.20E-03	1.18E-06	2.94E-06	1.29E-05
Fluoranthene	3.00E-06	2.94E-09	7.35E-09	3.22E-08
Fluorene	2.80E-06	2.75E-09	6.86E-09	3.01E-08
Formaldehyde	7.50E-02	7.35E-05	1.84E-04	8.05E-04
n-Hexane	1.80E+00	1.76E-03	4.41E-03	1.93E-02
Indeno(1,2,3-cd)pyrene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Naphthalene	6.10E-04	5.98E-07	1.50E-06	6.55E-06
Phenanathrene	1.70E-05	1.67E-08	4.17E-08	1.83E-07
Pyrene	5.00E-06	4.90E-09	1.23E-08	5.37E-08
Toluene	3.40E-03	3.33E-06	8.33E-06	3.65E-05
Total:			**4.61E-03**	**0.02**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3). Emission factors converted from lb/10^6 scf to lb/MMBtu by dividing by the average heat value of natural gas: 1,020 Btu/scf.

Table B.14. - Separator Burner Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
CO_2	53.06	116.98	292.44	1,280.90
CH_4	1.00E-03	2.20E-03	5.51E-03	0.02
N_2O	1.00E-04	2.20E-04	5.51E-04	2.41E-03
		Total CO_2e:	**292.75**	**1,282.22**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Crude Oil/Condensate Storage Tanks

Table B.15. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Information

Parameter	Value
Tank Vapor Volume, scfm	148.92
Tank Vapor Heating Value, Btu/scf	2,715.46
Total Gas Volume per Hour, MMSCF/hr	0.00894

Note: Tank vapor volume and heating value from E&P Tanks modeling run.

Table B.16. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.45E-03	0.18	0.79
$PM_{2.5}$ [1]	7.60	7.45E-03	0.18	0.79
SO_2	0.60	5.88E-04	0.01	0.06
NO_X	-	0.07	1.65	7.23
CO	-	0.31	7.52	32.94
VOC	5.50	5.39E-03	0.13	0.57

Note: Emission factors for NO_X and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_X\ and\ CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, SO_2, and VOC from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, SO_2, or\ VOC, \frac{lb}{hr} = \left[Total\ gas\ volume, \frac{10^6\ \text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6\ \text{scf}}\right]\ x\ \frac{Produced\ Gas\ heating\ value\ \left[\frac{btu}{scf}\right]}{Average\ NG\ heating\ value\ (1{,}020)\left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.17. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	5.71E-07	2.50E-06
3-Methylchloranthrene	1.80E-06	4.28E-08	1.88E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	3.81E-07	1.67E-06
Acenaphthene	1.80E-06	4.28E-08	1.88E-07
Anthracene	2.40E-06	5.71E-08	2.50E-07
Benz(a)anthracene	1.80E-06	4.28E-08	1.88E-07
Benzene	2.10E-03	5.00E-05	2.19E-04
Benzo(a)pyrene	1.20E-06	2.85E-08	1.25E-07
Benzo(b)fluoranthene	1.80E-06	4.28E-08	1.88E-07
Benzo(g,h,i)perylene	1.20E-06	2.85E-08	1.25E-07
Benzo(k)fluoranthene	1.80E-06	4.28E-08	1.88E-07
Crysene	1.80E-06	4.28E-08	1.88E-07
Dibenzo(a,h)anthracene	1.20E-06	2.85E-08	1.25E-07
Dichlorobenzene	1.20E-03	2.85E-05	1.25E-04
Fluoranthene	3.00E-06	7.14E-08	3.13E-07
Fluorene	2.80E-06	6.66E-08	2.92E-07
Formaldehyde	7.50E-02	1.78E-03	7.81E-03
n-Hexane	1.80E+00	4.28E-02	1.88E-01
Indeno(1,2,3-cd)pyrene	1.80E-06	4.28E-08	1.88E-07
Naphthalene	6.10E-04	1.45E-05	6.36E-05
Phenanathrene	1.70E-05	4.04E-07	1.77E-06
Pyrene	5.00E-06	1.19E-07	5.21E-07
Toluene	3.40E-03	8.09E-05	3.54E-04
Total:		**0.04**	**0.20**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.18. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	2,838.18	12,431.22
CH_4	1.00E-03	2.20E-03	5.35E-02	0.23
N_2O	1.00E-04	2.20E-04	5.35E-03	2.34E-02
		Total CO_2e:	**2,841.11**	**12,444.06**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Crude Oil/Condensate Storage Tanks

Table B.19. - E&P Tank Modeling Results and Percent Total

Parameter	Uncontrolled Emissions E&P Tanks Model Results, tpy			Controlled Emissions E&P Tanks Model Results, tpy		
	Flashing	Working & Breathing	Total	Flashing	Working & Breathing	Total
Total Emissions	974.62	3,813.39	4,788.01	19.49	76.27	95.76
Emissions per Tank	60.91	238.34	299.25	1.22	4.77	5.99
Percent of Total	20.4%	79.6%	100%	20.4%	79.6%	100%

Note: Flashing and working & breathing losses are only provided for uncontrolled emissions in the E&P Tank model. These percentages of the total (20.4% for flashing emissions and 79.6% for working & breathing emissions) were used to estimate emissions for other pollutants (below, in Table B.20).

Table B.20. - Crude Oil/Condensate Storage Tank Emissions

Parameter	Uncontrolled Emissions E&P Tanks Model Results				Controlled Emissions E&P Tanks Model Results, tpy			Controlled Emissions: Calculated Tank Vapor Combustion Emissions, tpy	Total Emissions		Emissions per Tank	
	Flashing	Working & Breathing	Total, lb/hr	Total, tpy	Flashing	Working & Breathing	Total, tpy		lb/hr	tpy	lb/hr	tpy
VOC	839.99	3,286.64	942.15	4,126.64	16.80	65.73	82.53	0.57	18.97	83.10	1.19	5.19
Total CO_2e	151.29	591.96	169.69	743.26	4.22	16.51	20.73	12,444.06	2,845.84	12,464.79	177.87	779.05
CH_4	6.00	23.49	6.73	29.49	0.12	0.47	0.59	0.23	0.19	0.82	0.01	0.05
CO_2	1.22	4.77	1.37	5.98	1.22	4.77	5.98	12,431.22	2,839.54	12,437.20	177.47	777.33
N_2O	-	-	-	-	-	-	-	0.02	5.35E-03	0.02	3.34E-04	1.46E-03
Total HAPs	11.16	43.66	12.52	54.82	0.22	0.87	1.10	0.20	0.30	1.29	0.02	0.08
Benzene	0.98	3.84	1.10	4.83	0.02	0.08	0.10	2.19E-04	0.02	0.10	1.38E-03	6.05E-03
Toluene	0.50	1.95	0.56	2.45	0.01	0.04	0.05	3.54E-04	0.01	0.05	7.05E-04	3.09E-03
Ethylbenzene	0.07	0.26	0.07	0.32	1.31E-03	5.11E-03	6.42E-03	-	1.47E-03	6.42E-03	9.16E-05	4.01E-04
Xylene	0.27	1.05	0.30	1.32	5.38E-03	0.02	0.03	-	6.03E-03	0.03	3.77E-04	1.65E-03
n-C6	8.54	33.40	9.58	41.94	0.17	0.67	0.84	0.19	0.23	1.03	0.01	0.06
2,2,4-Trimethylpentane	0.81	3.15	0.90	3.96	0.02	0.06	0.08	-	0.02	0.08	1.13E-03	4.95E-03
H_2S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00
PM_{10}	-	-	-	-	-	-	-	0.79	0.18	0.79	0.01	0.05
$PM_{2.5}$	-	-	-	-	-	-	-	0.79	0.18	0.79	0.01	0.05
SO_2	-	-	-	-	-	-	-	0.06	0.01	0.06	8.92E-04	3.91E-03
NO_X	-	-	-	-	-	-	-	7.23	1.65	7.23	0.10	0.45
CO	-	-	-	-	-	-	-	32.94	7.52	32.94	0.47	2.06

Note: Uncontrolled and controlled emissions from E&P Tank model run using the oil analysis dated March 6, 2017, included in this appendix. Assumed 98% control efficiency for the flare. Flashing and working & breathing losses estimated for the pollutants above as a percentage of their total emissions (see Table B.19). For example, total uncontrolled flashing emissions was equal to 20.4% of total uncontrolled emissions. Therefore, for VOC, flashing emissions are 20.4% of total uncontrolled VOC emissions. Emissions in pounds per hour assumed to occur over 8,760 hours per year.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Produced Water Tanks

Table B.21. - Produced Water Tanks Emissions

Pollutant	Uncontrolled Emissions		Controlled Emissions	
	lb/hr	tpy	lb/hr	tpy
VOC	0.07	0.29	1.31E-03	5.74E-03
Total CO_2e	0.01	0.06	4.30E-03	0.02
CH_4	4.04E-04	1.77E-03	8.08E-06	3.54E-05
CO_2	4.10E-03	0.02	4.10E-03	0.02
Total HAPs	7.51E-04	3.29E-03	1.50E-05	6.58E-05
Benzene	6.61E-05	2.89E-04	1.32E-06	5.79E-06
Toluene	3.36E-05	1.47E-04	6.71E-07	2.94E-06
Ethylbenzene	4.40E-06	1.93E-05	8.79E-08	3.85E-07
Xylene	1.81E-05	7.92E-05	3.62E-07	1.58E-06
n-C6	5.74E-04	2.52E-03	1.15E-05	5.03E-05
2,2,4-Trimethylpentane	5.42E-05	2.37E-04	1.08E-06	4.75E-06
H_2S	0.00	0.00	0.00	0.00

Note: Produced water tank emissions from EPA TANKS modeling run. Speciated HAPs are assumed to have the same proportion of emissions (HAP to VOC) as the crude oil/ condensate storage tanks. Assumed 98% control efficiency for the flare. Emissions in pounds per hour assumed to occur over 8,760 hours per year.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Steffes Engineered Flare Pilot

Table B.22. - Steffes Engineered Flare Pilot Information

Parameter	Value
Flare Pilot Usage, hours	8,760
Number of Flares	4
Flare Pilot Gas, scfm	0.2
Flare Pilot Gas Heating Value, Btu/scf	1,535.4
Total Gas Volume per Hour per Flare, MMSCF/hr	0.00001
Flare Control Efficiency	98%

Note: Flare pilot gas conservatively assumed and gas heating value is averaged from a produced gas analysis dated March 6, 2017.

Table B.23. - Steffes Engineered Flare Pilot Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.45E-03	5.03E-04	2.20E-03
$PM_{2.5}$ [1]	7.60	7.45E-03	5.03E-04	2.20E-03
SO_2	0.60	5.88E-04	3.97E-05	1.74E-04
NO_X	-	0.07	4.59E-03	2.01E-02
CO	-	0.31	0.02	9.17E-02
VOC	5.50	5.39E-03	3.64E-04	1.60E-03

Note: Emission factors for NO_X and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_X\ and\ CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, SO_2, and VOC from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, SO_2, or\ VOC, \frac{lb}{hr} = \left[Total\ gas\ volume, \frac{10^6\ \text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6\ \text{scf}}\right]\ x\ \frac{Produced\ Gas\ heating\ value\ \left[\frac{btu}{scf}\right]}{Average\ NG\ heating\ value\ (1{,}020)\left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.24. - Steffes Engineered Flare Pilot Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	1.59E-09	6.96E-09
3-Methylchloranthrene	1.80E-06	1.19E-10	5.22E-10
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.06E-09	4.64E-09
Acenaphthene	1.80E-06	1.19E-10	5.22E-10
Anthracene	2.40E-06	1.59E-10	6.96E-10
Benz(a)anthracene	1.80E-06	1.19E-10	5.22E-10
Benzene	2.10E-03	1.39E-07	6.09E-07
Benzo(a)pyrene	1.20E-06	7.95E-11	3.48E-10
Benzo(b)fluoranthene	1.80E-06	1.19E-10	5.22E-10
Benzo(g,h,i)perylene	1.20E-06	7.95E-11	3.48E-10
Benzo(k)fluoranthene	1.80E-06	1.19E-10	5.22E-10
Crysene	1.80E-06	1.19E-10	5.22E-10
Dibenzo(a,h)anthracene	1.20E-06	7.95E-11	3.48E-10
Dichlorobenzene	1.20E-03	7.95E-08	3.48E-07
Fluoranthene	3.00E-06	1.99E-10	8.70E-10
Fluorene	2.80E-06	1.85E-10	8.12E-10
Formaldehyde	7.50E-02	4.97E-06	2.18E-05
n-Hexane	1.80E+00	1.19E-04	5.22E-04
Indeno(1,2,3-cd)pyrene	1.80E-06	1.19E-10	5.22E-10
Naphthalene	6.10E-04	4.04E-08	1.77E-07
Phenanathrene	1.70E-05	1.13E-09	4.93E-09
Pyrene	5.00E-06	3.31E-10	1.45E-09
Toluene	3.40E-03	2.25E-07	9.86E-07
Total:		**1.25E-04**	**5.46E-04**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.25. - Steffes Engineered Flare Pilot Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	7.90	34.61
CH_4	1.00E-03	2.20E-03	1.49E-04	6.52E-04
N_2O	1.00E-04	2.20E-04	1.49E-05	6.52E-05
		Total CO_2e:	**7.91**	**34.65**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298,

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Fugitive Leaks

Table B.26. - Fugitive Emissions: Emission Factors for Total Hydrocarbon (THC) Emissions

Equipment Type	Equipment Service Category, lb/hr/source			
	Gas	Heavy Oil (< 20° API)	Light Oil (>20° API)	Water/Light Oil
Valves	9.92E-03	1.85E-05	5.51E-03	2.16E-04
Pump Seals	5.29E-03	-	2.87E-02	5.29E-05
Others	1.94E-02	7.05E-05	1.65E-02	3.09E-02
Connectors	4.41E-04	1.65E-05	4.63E-04	2.43E-04
Flanges	8.60E-04	8.60E-07	2.43E-04	6.39E-06
Open-Ended Lines	4.41E-03	3.09E-04	3.09E-03	5.51E-04

Note: From US EPA Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017). Emission factors converted from kg/source-hr to lb/source-hr The water/light oil emission factors apply to water streams in light oil service with water content between 50% and 99%. For streams with water content > 99%, the emission rate is considered negligible. The "other" equipment type includes compressor, pressure relief valves, diaphragms, drains, dump arms, hatches, instruments, meters, polished rods, and vents.

Table B.27. - Fugitive THC Emissions

Equipment Type	Number of Components	Service	Emission Factor, lb/hr/source	THC Emissions, lb/hr	THC Emissions, tpy
Valves	78	Gas	9.92E-03	0.77	3.39
Valves	78	Light Oil	5.51E-03	0.43	1.88
Valves	8	Water/Light Oil	2.16E-04	1.73E-03	0.01
Pump Seals	0	Gas	5.29E-03	0.00	0.00
Pump Seals	0	Light Oil	2.87E-02	0.00	0.00
Pump Seals	0	Water/Light Oil	5.29E-05	0.00	0.00
Others	0	Gas	1.94E-02	0.00	0.00
Others	0	Light Oil	1.65E-02	0.00	0.00
Others	0	Water/Light Oil	3.09E-02	0.00	0.00
Connectors	672	Gas	4.41E-04	0.30	1.30
Connectors	354	Light Oil	4.63E-04	0.16	0.72
Connectors	52	Water/Light Oil	2.43E-04	0.01	0.06
Flanges	4	Gas	8.60E-04	3.44E-03	0.02
Flanges	0	Light Oil	2.43E-04	0.00	0.00
Flanges	0	Water/Light Oil	6.39E-06	0.00	0.00
Open-Ended Lines	0	Gas	4.41E-03	0.00	0.00
Open-Ended Lines	0	Light Oil	3.09E-03	0.00	0.00
Open-Ended Lines	0	Water/Light Oil	5.51E-04	0.00	0.00
			Total THC Emissions:	**1.68**	**7.38**

Note: Number of components estimated from actual counts performed at similar facilities.

Table B.28. - Speciated Fugitive Emission Factors

Pollutant	Weight Fraction	Weight Fraction	Weight Fraction	Emissions, lb/hr	Emissions, tpy
	Gas	Light Oil	Water/Light Oil		
THC	1.00	1.00	1.00	1.68	7.37
VOC	0.84	1.00	1.00	1.51	6.61
Total CO_2e	-	-	-	0.19	0.85
CH_4	7.20E-03	0.00	0.00	0.01	0.03
CO_2	1.46E-03	0.00	0.00	1.57E-03	0.01
Total HAPs	1.23E-02	0.11	0.11	0.08	0.34
Benzene	1.05E-03	6.64E-03	6.64E-03	0.01	0.02
Toluene	7.08E-05	1.12E-02	1.12E-02	0.01	0.03
Ethylbenzene	5.35E-04	4.16E-03	4.16E-03	3.10E-03	0.01
Xylenes	9.43E-03	1.99E-02	1.99E-02	0.02	0.10
n-Hexane	2.76E-04	5.14E-02	5.14E-02	0.03	0.14
2,2,4-Trimethylpentane	9.12E-04	1.18E-02	1.18E-02	0.01	0.04
H_2S	0.00	0.00	0.00	0.00	0.00

Note: Water/Light Oil and Light Oil Weight fractions based on E&P Tank modeling run flashed gas results for the oil storage tanks. All stream weight fractions for organic compounds used in calculations are normalized based on 100% THC since EPA emission factors are based on THC emission rate. Produced gas speciated HAPs are proportionally based on the speciated HAPs in the E&P TANK v2.0 flashed gas results, then normalized based on 100% THC.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Truck Loading

Table B.29. - Truck Loading Emissions Calculation Inputs - Produced Water Only

Parameter	Value
Saturation Factor (S)	0.6
True Vapor Pressure of Liquid Loaded (P), psia	0.24
Molecular Weight of Vapors (M), lb/lb-mole	20.68
Temperature of Bulk Liquid Loaded (T), °F	41.45
Loading Losses, lb/1,000 gallons	**0.08**
Water Production, BPD	767.9
Average Water Loadout Rate, gallons/hr	1,343.9
Maximum Water Loadout Rate, gallons/hr	7,560.0
Maximum Yearly Throughput, gallons/yr	11,772,229

Note: Loading losses based on EPA AP-42 Section 5.2-4:

$$L_L = 12.46 \frac{SPM}{(T + 460)}$$

Saturation factor based on submerged loading: dedicated normal service. Molecular weight of vapors and liquid bulk temperature from EPA Tank run. TVP of liquid loaded is assumed to be the maximum vapor pressure from hottest month (July) to be conservative.

Table B.30. - Truck Loading Emissions in Tons Per Year

Pollutant	Weight Fraction	Produced Water Loading	
		lb/hr	tpy
THC	1.00	0.57	0.44
VOC	0.84	0.48	0.37
Total CO_2e	-	0.10	0.08
CH_4	7.20E-03	4.08E-03	3.18E-03
CO_2	1.46E-03	8.28E-04	6.44E-04
Total HAPs	1.23E-02	0.01	5.42E-03
Benzene	1.05E-03	5.97E-04	4.65E-04
Toluene	7.08E-05	4.02E-05	3.13E-05
Ethylbenzene	5.35E-04	3.03E-04	2.36E-04
Xylenes	9.43E-03	0.01	4.16E-03
n-Hexane	2.76E-04	1.57E-04	1.22E-04
2,2,4-Trimethylpentane	9.12E-04	5.17E-04	4.03E-04
H_2S	0.00	0.00	0.00

Note: Weight fractions based on E&P Tank modeling run working and breathing gas composition for the crude oil/condensate storage tanks, which is included in this appendix. Truck loading emissions in lb/hr use maximum loadout rate. Note that crude oil/condensate is removed from site via pipeline so no loading emissions for crude oil/condensate are calculated.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Compressor Engine 1

Table B.31. - Engine Information

Parameter	Value
Engine #1 Horsepower (hp)	400
Number of Units	1
Fuel	Natural Gas
Annual Hours of Operation per Unit (hr)	8,760
Fuel Heat Rating (Btu/hr) [1]	3,290,000
Maximum Heat Input (MMBtu/hr)	3.29
Fuel Specific HHV (Btu/scf)	1,020
Fuel Use Rate (scf/hr)	3,225.49
Annual Fuel Consumption (MMBtu/year)	28,820.40
Annual Fuel Consumption (MMSCF/year)	28.26

[1] Values from engine manufacturer's specifications.

Table B.32. - Uncontrolled Compressor Engine Emissions

Component	Uncontrolled Emission Factor [1]		Uncontrolled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	26.27	23.17	101.47
CO	-	1.60	1.41	6.18
VOCs	-	0.16	0.14	0.62
Formaldehyde	2.05E-02	-	6.74E-02	0.30
$PM_{2.5}$	9.50E-03	-	3.13E-02	0.14
PM_{10}	9.50E-03	-	3.13E-02	0.14
PM	9.10E-03	-	2.99E-02	0.13
SO_2	5.88E-04	-	1.93E-03	0.01
CH_4	0.23	-	0.76	3.31
N_2O	1.32E-03	-	4.35E-03	0.02
CO_2	110.00	-	361.90	1,585.12
CO_2e [2]	110.00	-	382.11	1,673.66

[1] The emission factors for CO, NOx, and VOC are based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Table B.33. - Controlled Compressor Engine Emissions

Component	Controlled Emission Factor [1]		Controlled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	1.00	0.88	3.86
CO	-	2.00	1.76	7.72
VOCs	-	0.70	0.62	2.70
Formaldehyde	2.05E-02	-	6.74E-02	0.30
$PM_{2.5}$	9.50E-03	-	3.13E-02	0.14
PM_{10}	9.50E-03	-	3.13E-02	0.14
PM	9.10E-03	-	2.99E-02	0.13
SO_2	5.88E-04	-	1.93E-03	0.01
CH_4	0.23	-	0.76	3.31
N_2O	1.32E-03	-	4.35E-03	0.02
CO_2	-	459.00	404.77	1,772.89
CO_2e [2]	-	-	424.98	1,861.43

[1] The emission factors for CO, NOx, and VOC are based on the gram per brake-horsepower-hour (g/bhp-hr) uncontrolled rates. Engines would meet the emission standards of NSPS JJJJ for Non-Emergency Natural Gas Engines. The emission factor CO_2 is based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Compressor Engine 1

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

Table B.34. - Compressor Engine HAP Emissions

Component	AP-42 Emission Factor [1]	Uncontrolled Emission Rate		Controlled Emission Rate	
	lb/MMBtu	lb/hr	tons/year	lb/hr	tons/year
1,1,2,2-Tetrachloroethane	2.53E-05	8.32E-05	3.65E-04	8.32E-05	3.65E-04
1,1,2-Trichloroethane	1.53E-05	5.03E-05	2.20E-04	5.03E-05	2.20E-04
1,3-Butadiene	6.63E-04	2.18E-03	9.55E-03	2.18E-03	9.55E-03
1,3-Dichloropropene	1.27E-05	4.18E-05	1.83E-04	4.18E-05	1.83E-04
Acetaldehyde	2.79E-03	9.18E-03	4.02E-02	9.18E-03	4.02E-02
Acrolein	2.63E-03	8.65E-03	3.79E-02	8.65E-03	3.79E-02
Benzene	1.58E-03	5.20E-03	2.28E-02	5.20E-03	2.28E-02
Carbon Tetrachloride	1.77E-05	5.82E-05	2.55E-04	5.82E-05	2.55E-04
Chlorobenzene	1.29E-05	4.24E-05	1.86E-04	4.24E-05	1.86E-04
Chloroform	1.37E-05	4.51E-05	1.97E-04	4.51E-05	1.97E-04
Ethylbenzene	2.48E-05	8.16E-05	3.57E-04	8.16E-05	3.57E-04
Ethylene Dibromide	2.13E-05	7.01E-05	3.07E-04	7.01E-05	3.07E-04
Methanol	3.06E-03	1.01E-02	4.41E-02	1.01E-02	4.41E-02
Methylene Chloride	4.12E-05	1.36E-04	5.94E-04	1.36E-04	5.94E-04
Naphthalene	9.71E-05	3.19E-04	1.40E-03	3.19E-04	1.40E-03
PAH	1.41E-04	4.64E-04	2.03E-03	4.64E-04	2.03E-03
Styrene	1.19E-05	3.92E-05	1.71E-04	3.92E-05	1.71E-04
Toluene	5.58E-04	1.84E-03	8.04E-03	1.84E-03	8.04E-03
Vinyl Chloride	7.18E-06	2.36E-05	1.03E-04	2.36E-05	1.03E-04
Xylene	1.95E-04	6.42E-04	2.81E-03	6.42E-04	2.81E-03
Total HAPs [2]	**3.24E-02**	**0.11**	**0.47**	**0.11**	**0.47**

[1] Emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

[2] Total HAPs emissions include formaldehyde emissions from Tables B.32 and B.33.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Compressor Engine 2

Table B.35. - Engine Information

Parameter	Value
Engine #2 Horsepower (hp)	215
Number of Units	1
Fuel	Natural Gas
Annual Hours of Operation per Unit (hr)	8,760
Fuel Heat Rating (Btu/hr) [1]	1,669,905
Maximum Heat Input (MMBtu/hr)	1.67
Fuel Specific HHV (Btu/scf)	1,020
Fuel Use Rate (scf/hr)	1,637.16
Annual Fuel Consumption (MMBtu/year)	14,628.37
Annual Fuel Consumption (MMSCF/year)	14.34

[1] Values from engine manufacturer's specifications.

Table B.36. - Uncontrolled Compressor Engine Emissions

Component	AP-42 Emission Factor [1]		Uncontrolled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	27.94	13.24	58.01
CO	-	1.40	0.66	2.91
VOCs	-	0.18	0.09	0.37
Formaldehyde	2.05E-02	-	3.42E-02	0.15
$PM_{2.5}$	0.0095	-	1.59E-02	0.07
PM_{10}	0.0095	-	1.59E-02	0.07
PM	0.0091	-	1.52E-02	0.07
SO_2	0.000588	-	9.82E-04	4.30E-03
CH_4	0.23	-	0.38	1.68
N_2O	1.32E-03	-	2.21E-03	0.01
CO_2	110.00	-	183.69	804.56
CO_2e [2]	110.00	-	193.95	849.50

[1] The emission factors for CO, NOx, and VOC are based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Table B.37. - Controlled Compressor Engine Emissions

Component	Controlled Emission Factor [1]		Controlled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	1.00	0.47	2.08
CO	-	2.00	0.95	4.15
VOCs	-	0.70	0.33	1.45
Formaldehyde	2.05E-02	-	3.42E-02	0.15
$PM_{2.5}$	9.50E-03	-	1.59E-02	0.07
PM_{10}	9.50E-03	-	1.59E-02	0.07
PM	9.10E-03	-	1.52E-02	0.07
SO_2	5.88E-04	-	9.82E-04	4.30E-03
CH_4	0.23	-	0.38	1.68
N_2O	1.32E-03	-	2.21E-03	0.01
CO_2	-	511.00	242.21	1,060.88
CO_2e [2]	-	511.00	252.47	1,105.82

[1] The emission factors for CO, NOx, and VOC are based on the gram per brake-horsepower-hour (g/bhp-hr) uncontrolled rates. Engines would meet the emission standards of NSPS JJJJ for Non-Emergency Natural Gas Engines. The emission factor CO_2 is based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Compressor Engine 2

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

Table B.38. - Compressor Engine HAP Emissions

Component	AP-42 Emission Factor [1]	Uncontrolled Emission Rate		Controlled Emission Rate	
	lb/MMBtu	lb/hr	tons/year	lb/hr	tons/year
1,1,2,2-Tetrachloroethane	2.53E-05	4.22E-05	1.85E-04	4.22E-05	1.85E-04
1,1,2-Trichloroethane	1.53E-05	2.55E-05	1.12E-04	2.55E-05	1.12E-04
1,3-Butadiene	6.63E-04	1.11E-03	4.85E-03	1.11E-03	4.85E-03
1,3-Dichloropropene	1.27E-05	2.12E-05	9.29E-05	2.12E-05	9.29E-05
Acetaldehyde	2.79E-03	4.66E-03	2.04E-02	4.66E-03	2.04E-02
Acrolein	2.63E-03	4.39E-03	1.92E-02	4.39E-03	1.92E-02
Benzene	1.58E-03	2.64E-03	1.16E-02	2.64E-03	1.16E-02
Carbon Tetrachloride	1.77E-05	2.96E-05	1.29E-04	2.96E-05	1.29E-04
Chlorobenzene	1.29E-05	2.15E-05	9.44E-05	2.15E-05	9.44E-05
Chloroform	1.37E-05	2.29E-05	1.00E-04	2.29E-05	1.00E-04
Ethylbenzene	2.48E-05	4.14E-05	1.81E-04	4.14E-05	1.81E-04
Ethylene Dibromide	2.13E-05	3.56E-05	1.56E-04	3.56E-05	1.56E-04
Methanol	3.06E-03	5.11E-03	2.24E-02	5.11E-03	2.24E-02
Methylene Chloride	4.12E-05	6.88E-05	3.01E-04	6.88E-05	3.01E-04
Naphthalene	9.71E-05	1.62E-04	7.10E-04	1.62E-04	7.10E-04
PAH	1.41E-04	2.35E-04	1.03E-03	2.35E-04	1.03E-03
Styrene	1.19E-05	1.99E-05	8.70E-05	1.99E-05	8.70E-05
Toluene	5.58E-04	9.32E-04	4.08E-03	9.32E-04	4.08E-03
Vinyl Chloride	7.18E-06	1.20E-05	5.25E-05	1.20E-05	5.25E-05
Xylene	1.95E-04	3.26E-04	1.43E-03	3.26E-04	1.43E-03
Total HAPs [2]	**3.24E-02**	**5.41E-02**	**0.24**	**5.41E-02**	**0.24**

[1] Emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

[2] Total HAPs emissions include formaldehyde emissions from Tables B.36 and B.37.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Produced Gas

Table B.39. - Produced Gas Sent to Flare Information

Parameter	Value
Produced Gas Volume, MCFD	325.09
Produced Gas Volume, scf/hr	13,545.62
Produced Gas Heating Value, Btu/scf	1,535.40
Total Gas Volume per Hour, 10^6 scf/hr	0.01

Note: The wells are connected to a gas sales pipeline. The flared gas volumes for the US12H and US13H wells are based on the percentage of gas flared for the US8H well. Heating value based on gas analysis dated March 6, 2017 (included in this appendix).

Table B.40. - Produced Gas Sent to Flare Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.451E-03	0.15	0.68
$PM_{2.5}$ [1]	7.60	7.451E-03	0.15	0.68
SO_2	0.60	5.882E-04	0.01	0.05
NO_X	-	0.07	1.41	6.19
CO	-	0.31	6.45	28.24
VOC	5.50	5.392E-03	0.11	0.49

Note: SO_2 and VOC emissions are calculated using fuel in Table B.36. Emission factors for NOX and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_x\ and\ CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, VOC, and SO_2 from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, \frac{lb}{hr} = \left[Total\ gas\ volume, \frac{10^6\ \text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6\ \text{scf}}\right]\ x\ \frac{Produced\ Gas\ heating\ value\ \left[\frac{btu}{scf}\right]}{Average\ NG\ heating\ value\ (1{,}020)\left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.41. - Produced Gas Sent to Flare Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	4.89E-07	2.14E-06
3-Methylchloranthrene	1.80E-06	3.67E-08	1.61E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	3.26E-07	1.43E-06
Acenaphthene	1.80E-06	3.67E-08	1.61E-07
Anthracene	2.40E-06	4.89E-08	2.14E-07
Benz(a)anthracene	1.80E-06	3.67E-08	1.61E-07
Benzene	2.10E-03	4.28E-05	1.88E-04
Benzo(a)pyrene	1.20E-06	2.45E-08	1.07E-07
Benzo(b)fluoranthene	1.80E-06	3.67E-08	1.61E-07
Benzo(g,h,i)perylene	1.20E-06	2.45E-08	1.07E-07
Benzo(k)fluoranthene	1.80E-06	3.67E-08	1.61E-07
Crysene	1.80E-06	3.67E-08	1.61E-07
Dibenzo(a,h)anthracene	1.20E-06	2.45E-08	1.07E-07
Dichlorobenzene	1.20E-03	2.45E-05	1.07E-04
Fluoranthene	3.00E-06	6.12E-08	2.68E-07
Fluorene	2.80E-06	5.71E-08	2.50E-07
Formaldehyde	7.50E-02	1.53E-03	6.70E-03
n-Hexane	1.80E+00	3.67E-02	1.61E-01
Indeno(1,2,3-cd)pyrene	1.80E-06	3.67E-08	1.61E-07
Naphthalene	6.10E-04	1.24E-05	5.45E-05
Phenanathrene	1.70E-05	3.47E-07	1.52E-06
Pyrene	5.00E-06	1.02E-07	4.47E-07
Toluene	3.40E-03	6.93E-05	3.04E-04
Total:		**0.04**	**0.17**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.42. - Produced Gas Sent to Flare Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	2,432.89	10,656.04
CH_4	1.00E-03	2.20E-03	0.05	0.20
N_2O	1.00E-04	2.20E-04	0.00	0.02
		Total CO_2e:	**2,435.40**	**10,667.05**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
PTE Emission Calculations
Produced Gas

Table B.43. - Flare and Produced Gas Information

Parameter	Value
Flare Destruction Efficiency, %	98
Specific Gravity of Produced Gas	0.92
Molecular Weight of Produced Gas, lb/lb-mole	26.53
HHV of Produced Gas, Btu/scf	1,535.40
Volume of Produced Gas to Flare, MCFD	325.09
Volume of Produced Gas to Flare, scf/hr	13,545.62

Note: Heating value based on gas analysis dated March 6, 2017 (included in this appendix). Molecular weight of gas calculated by multiplying the specific gravity by the molecular weight of air (28.96443 lb/lb-mole).

Table B.44. - Uncontrolled and Controlled Produced Gas Emissions

Pollutant	Gas Analysis Data		Uncontrolled		Controlled		Calculated Combustion Emissions, tpy	Total Controlled Emissions	
	Weight Percent	Mole Percent	lb/hr	tpy	lb/hr	tpy		lb/hr	tpy
VOC	37.76	-	358.09	1,568.43	7.16	31.37	0.49	7.27	31.86
Total CO_2e	-	-	8,149.34	35,694.09	172.75	756.64	10,667.05	2,608.15	11,423.68
CH_4	34.33	-	325.57	1,426.02	6.51	28.52	0.20	6.56	28.72
CO_2	1.05	-	9.96	43.63	9.96	43.63	10,656.04	2,442.85	10,699.67
N_2O	-	-	-	-	-	-	0.02	4.59E-03	0.02
Total HAPs	0.74	-	7.01	30.69	0.14	0.61	0.17	0.18	0.78
Benzene	0.06	-	0.60	2.63	0.01	0.05	1.88E-04	0.01	0.05
Toluene	0.32	-	3.05	13.37	0.06	0.27	3.04E-04	0.06	0.27
Ethylbenzene	4.26E-03	-	0.04	0.18	8.08E-04	3.54E-03	-	8.08E-04	3.54E-03
Xylene	0.02	-	0.16	0.69	3.15E-03	0.01	-	3.15E-03	0.01
n-C6	0.74	-	7.01	30.69	0.14	0.61	0.16	0.18	0.77
2,2,4-Trimethylpentane	0.05	-	0.52	2.28	0.01	0.05	-	0.01	0.05
H_2S	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM_{10}	-	-	-	-			0.68	0.16	0.68
$PM_{2.5}$	-	-	-	-			0.68	0.16	0.68
SO_2	-	-	-	-			0.05	0.01	0.05
NO_X	-	-	-	-			6.19	1.41	6.19
CO	-	-	-	-			28.24	6.45	28.24

Note: Speciated HAPs are proportionally based on the speciated HAPs in the E&P TANK v2.0 flashed gas results. Emission factors for NO_X and CO from AP-42, Chapter 13.5, Industrial Flares, Table 13.5-1. Emissions in tons per year assume flaring 8,760 hours per year. Uncontrolled emissions for VOC, HAPs, and H_2S were calculated using the following equation:

$$VOC, HAPs, and\ H_2S\ uncontrolled\ emission\ rate, \frac{lb}{hr} = Molecular\ weight, \frac{\text{lb}}{\text{lb−mole}} \times \frac{1\ \text{lb−mole}}{379\ \text{scf}} \times Volume\ of\ gas, \frac{\text{scf}}{\text{hr}} \times Weight\ Percent$$

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Emission Sources

Table B.1. - Emission Sources

Emission Unit	Quantity	Rating/Capacity
2-Phase Separators w/Heater Treater	2	1.0 MMBtu/hr each
2-Phase Separators w/Heater Treater	1	0.5 MMBtu/hr
Crude Oil/Condensate Storage Tanks	8	400 BBL each
Crude Oil/Condensate Storage Tanks	8	1,000 BBL each
Produced Water Storage Tanks	4	400 BBL each
Produced Water Storage Tanks	4	1,000 BBL each
Flares	4	21.45 scf/hr pilot rating
Fugitive Leaks	-	-
Truck Loading	-	N/A
Compressor Engine	1	400 horsepower
Compressor Engine	1	215 horsepower
Produced Gas	-	-

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Emissions Summaries

Table B.2. - Summary of Uncontrolled Emissions in Pounds per Hour

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.01	0.00	0.25	0.21	0.00	-	0.02	0.02	292.75
(16) Crude Oil/Condensate Storage Tanks	608.79	8.09	-	-	-	0.00	-	-	109.65
(8) Produced Water Storage Tanks	0.06	0.00	-	-	-	0.00	-	-	0.01
(4) Flares Pilots	-	-	-	-	-	-	-	-	-
Fugitive Leaks	1.51	0.08	-	-	-	0.00	-	-	0.19
Truck Loading	0.48	0.01	-	-	-	0.00	-	-	0.10
(2) Compressor Engines	0.23	0.16	36.41	2.07	0.00	-	0.05	0.05	576.06
Produced Gas	178.69	3.50	-	-	-	0.00	-	-	4,066.53
Total	**789.76**	**11.83**	**36.65**	**2.28**	**0.00**	**0.00**	**0.07**	**0.07**	**5,045.30**

Table B.3. - Summary of Uncontrolled Emissions in Tons Per Year

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.06	0.02	0.25	0.21	0.00	-	0.08	0.08	1,282.22
(16) Crude Oil/Condensate Storage Tanks	2,666.49	35.42	-	-	-	0.00	-	-	480.27
(8) Produced Water Storage Tanks	0.26	0.00	-	-	-	0.00	-	-	0.06
(4) Flares Pilots	-	-	-	-	-	-	-	-	-
Fugitive Leaks	6.61	0.34	-	-	-	0.00	-	-	0.85
Truck Loading	0.25	0.00	-	-	-	0.00	-	-	0.05
(2) Compressor Engines	0.99	0.70	159.47	9.09	0.01	-	0.21	0.21	2,523.16
Produced Gas	782.65	15.31	-	-	-	0.00	-	-	17,811.42
Total	**3,457.30**	**51.80**	**159.72**	**9.29**	**0.01**	**0.00**	**0.29**	**0.29**	**22,098.03**

Table B.4. - Summary of Controlled Emissions in Pounds per Hour

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.01	0.00	0.25	0.21	0.00	-	0.02	0.02	292.75
(16) Crude Oil/Condensate Storage Tanks	12.26	0.19	1.07	4.86	0.01	0.00	0.12	0.12	1,838.84
(8) Produced Water Storage Tanks	0.00	0.00	-	-	-	0.00	-	-	0.00
(4) Flares Pilots	0.00	0.00	0.00	0.02	0.00	-	0.00	0.00	7.91
Fugitive Leaks	1.51	0.08	-	-	-	0.00	-	-	0.19
Truck Loading	0.48	0.01	-	-	-	0.00	-	-	0.10
(2) Compressor Engines	0.95	0.16	1.36	2.71	0.00	-	0.05	0.05	677.45
Produced Gas	3.63	0.09	0.71	3.22	0.01	0.00	0.08	0.08	1,301.47
Total	**18.84**	**0.53**	**3.38**	**11.02**	**0.02**	**0.00**	**0.26**	**0.26**	**4,118.72**

Table B.5. - Summary of Controlled Emissions in Tons Per Year

Emission Source	VOC	HAPs	NO_X	CO	SO_2	H_2S	PM_{10}	$PM_{2.5}$	CO_2e
2-Phase Separators w/Heater Treater	0.06	0.02	1.07	0.90	0.01	-	0.08	0.08	1,282.22
(16) Crude Oil/Condensate Storage Tanks	53.70	0.84	4.67	21.29	0.04	0.00	0.51	0.51	8,054.10
(8) Produced Water Storage Tanks	0.01	0.00	-	-	-	0.00	-	-	0.02
(4) Flares Pilots	0.00	0.00	0.02	0.09	0.00	-	0.00	0.00	34.65
Fugitive Leaks	6.61	0.34	-	-	-	0.00	-	-	0.85
Truck Loading	0.25	0.00	-	-	-	0.00	-	-	0.05
(2) Compressor Engines	4.16	0.70	5.94	11.88	0.01	-	0.21	0.21	2,967.25
Produced Gas	15.90	0.39	3.09	14.09	0.03	0.00	0.34	0.34	5,700.44
Total	**80.68**	**2.29**	**14.79**	**48.25**	**0.09**	**0.00**	**1.14**	**1.14**	**18,039.59**

Petroshale (US), Inc.
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Table B.6. - Summary of Uncontrolled HAP Emissions in Pounds per Hour

Hazardous Air Pollutant	Separators	Condensate Tanks	Produced Water Tanks	Flare Pilots	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	8.3E-05	**8.3E-05**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	5.0E-05	**5.0E-05**
1,3-Butadiene	-	-	-	-	-	-	-	2.2E-03	**2.2E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
2-Methylnaphthalene	5.9E-08	-	-	-	-	-	-	-	**5.9E-08**
2,2,4-Trimethylpentane	-	0.58	0.00	-	0.01	0.00	0.26	-	**0.85**
3-Methylchloranthrene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
7,12-Dimethylbenz(a)anthracene	3.9E-08	-	-	-	-	-	-	-	**3.9E-08**
Acenaphthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Acetaldehyde	-	-	-	-	-	-	-	9.2E-03	**9.2E-03**
Acrolein	-	-	-	-	-	-	-	8.7E-03	**8.7E-03**
Anthracene	5.9E-09	-	-	-	-	-	-	-	**5.9E-09**
Benzene	5.1E-06	0.71	5.9E-05	-	5.2E-03	6.0E-04	0.30	5.2E-03	**1.02**
Benzo(a)anthracene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(a)pyrene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Benzo(b)fluoranthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(k)fluoranthene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Benzo(g,h,i)perylene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Carbon Tetrachloride	-	-	-	-	-	-	-	5.8E-05	**5.8E-05**
Chlorobenzene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
Chloroform	-	-	-	-	-	-	-	4.5E-05	**4.5E-05**
Chrysene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Dibenz(a,h)anthracene	2.9E-09	-	-	-	-	-	-	-	**2.9E-09**
Dichlorobenzene	2.9E-06	-	-	-	-	-	-	-	**2.9E-06**
Ethylbenzene	-	4.7E-02	3.9E-06	-	3.1E-03	3.0E-04	0.02	8.2E-05	**0.07**
Ethylene Dibromide	-	-	-	-	-	-	-	7.0E-05	**7.0E-05**
Fluoranthene	7.4E-09	-	-	-	-	-	-	-	**7.4E-09**
Fluorene	6.9E-09	-	-	-	-	-	-	-	**6.9E-09**
Formaldehyde	1.8E-04	-	-	-	-	-	-	6.74E-02	**6.76E-02**
n-Hexane	4.4E-03	6.19	5.1E-04	-	0.03	0.00	3.50	-	**9.72**
Indeno(1,2,3-cd)pyrene	4.4E-09	-	-	-	-	-	-	-	**4.4E-09**
Methanol	-	-	-	-	-	-	-	1.0E-02	**1.0E-02**
Methylene Chloride	-	-	-	-	-	-	-	1.4E-04	**1.4E-04**
Naphthalene	1.5E-06	-	-	-	-	-	-	3.2E-04	**3.2E-04**
PAH	-	-	-	-	-	-	-	4.6E-04	**4.6E-04**
Phenanathrene	4.2E-08	-	-	-	-	-	-	-	**4.2E-08**
Pyrene	1.2E-08	-	-	-	-	-	-	-	**1.2E-08**
Styrene	-	-	-	-	-	-	-	3.9E-05	**3.9E-05**
Toluene	8.3E-06	0.36	3.0E-05	-	6.9E-03	4.0E-05	1.52	1.8E-03	**1.89**
Vinyl Chloride	-	-	-	-	-	-	-	2.4E-05	**2.4E-05**
Xylene	-	0.19	1.6E-05	-	2.2E-02	5.3E-03	0.08	6.4E-04	**0.30**
Total	**4.61E-03**	**8.09**	**6.71E-04**	**0.00**	**0.08**	**0.01**	**5.68**	**0.11**	***13.96***

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Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
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Table B.7. - Summary of Controlled HAP Emissions in Pounds per Hour

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	8.3E-05	**8.3E-05**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	5.0E-05	**5.0E-05**
1,3-Butadiene	-	-	-	-	-	-	-	2.2E-03	**2.2E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
2-Methylnaphthalene	5.9E-08	-	-	1.6E-09	-	-	-	-	**6.0E-08**
2,2,4-Trimethylpentane	-	0.01	0.00	-	0.01	0.00	0.01	-	**0.03**
3-Methylchloranthrene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
7,12-Dimethylbenz(a)anthracene	3.9E-08	-	-	1.1E-09	-	-	-	-	**4.0E-08**
Acenaphthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Acetaldehyde	-	-	-	-	-	-	-	9.2E-03	**9.2E-03**
Acrolein	-	-	-	-	-	-	-	8.7E-03	**8.7E-03**
Anthracene	5.9E-09	-	-	1.6E-10	-	-	-	-	**6.0E-09**
Benzene	5.1E-06	1.4E-02	1.2E-06	1.4E-07	5.2E-03	6.0E-04	0.01	5.2E-03	**0.03**
Benzo(a)anthracene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(b)fluoranthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(k)fluoranthene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Benzo(a)pyrene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Benzo(g,h,l)perylene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Carbon Tetrachloride	-	-	-	-	-	-	-	5.8E-05	**5.8E-05**
Chlorobenzene	-	-	-	-	-	-	-	4.2E-05	**4.2E-05**
Chloroform	-	-	-	-	-	-	-	4.5E-05	**4.5E-05**
Chrysene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Dibenz(a,h)anthracene	2.9E-09	-	-	7.9E-11	-	-	-	-	**3.0E-09**
Dichlorobenzene	2.9E-06	-	-	7.9E-08	-	-	-	-	**3.0E-06**
Ethylbenzene	-	9.5E-04	7.9E-08	-	3.1E-03	3.0E-04	4.0E-04	8.2E-05	**4.8E-03**
Ethylene Dibromide	-	-	-	-	-	-	-	7.0E-05	**7.0E-05**
Fluoranthene	7.4E-09	-	-	2.0E-10	-	-	-	-	**7.6E-09**
Fluorene	6.9E-09	-	-	1.9E-10	-	-	-	-	**7.0E-09**
Formaldehyde	1.8E-04	-	-	5.0E-06	-	-	-	6.74E-02	**6.76E-02**
n-Hexane	4.4E-03	0.15	1.0E-05	1.2E-04	0.03	0.00	0.09	-	**0.28**
Indeno(1,2,3-cd)pyrene	4.4E-09	-	-	1.2E-10	-	-	-	-	**4.5E-09**
Methanol	-	-	-	-	-	-	-	1.0E-02	**1.0E-02**
Methylene Chloride	-	-	-	-	-	-	-	1.4E-04	**1.4E-04**
Naphthalene	1.5E-06	-	-	4.0E-08	-	-	-	3.2E-04	**3.2E-04**
PAH	-	-	-	-	-	-	-	4.6E-04	**4.6E-04**
Phenanathrene	4.2E-08	-	-	1.1E-09	-	-	-	-	**4.3E-08**
Pyrene	1.2E-08	-	-	3.3E-10	-	-	-	-	**1.3E-08**
Styrene	-	-	-	-	-	-	-	3.9E-05	**3.9E-05**
Toluene	8.3E-06	7.3E-03	6.0E-07	2.3E-07	6.9E-03	4.0E-05	0.03	1.8E-03	**0.05**
Vinyl Chloride	-	-	-	-	-	-	-	2.4E-05	**2.4E-05**
Xylene	-	3.9E-03	3.2E-07	-	2.2E-02	5.3E-03	0.00	6.4E-04	**0.03**
Total	**4.61E-03**	**0.19**	**1.34E-05**	**1.25E-04**	**0.08**	**0.01**	**0.13**	**0.11**	***0.52***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
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Table B.8. - Summary of Uncontrolled HAP Emissions in Tons per Year

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	3.6E-04	**3.6E-04**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	2.2E-04	**2.2E-04**
1,3-Butadiene	-	-	-	-	-	-	-	9.6E-03	**9.6E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	1.8E-04	**1.8E-04**
2-Methylnaphthalene	2.6E-07	-	-	-	-	-	-	-	**2.6E-07**
2,2,4-Trimethylpentane	-	2.56	0.00	-	0.04	0.00	1.14	-	**3.73**
3-Methylchloranthrene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
7,12-Dimethylbenz(a)anthracene	1.7E-07	-	-	-	-	-	-	-	**1.7E-07**
Acenaphthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Acetaldehyde	-	-	-	-	-	-	-	0.04	**0.04**
Acrolein	-	-	-	-	-	-	-	3.8E-02	**3.8E-02**
Anthracene	2.6E-08	-	-	-	-	-	-	-	**2.6E-08**
Benzene	2.3E-05	3.12	2.6E-04	-	2.3E-02	3.1E-04	1.31	2.3E-02	**4.48**
Benzo(a)anthracene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(b)fluoranthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(k)fluoranthene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Benzo(a)pyrene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Benzo(g,h,l)perylene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Carbon Tetrachloride	-	-	-	-	-	-	-	2.6E-04	**2.6E-04**
Chlorobenzene	-	-	-	-	-	-	-	1.9E-04	**1.9E-04**
Chloroform	-	-	-	-	-	-	-	2.0E-04	**2.0E-04**
Chrysene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Dibenz(a,h)anthracene	1.3E-08	-	-	-	-	-	-	-	**1.3E-08**
Dichlorobenzene	1.3E-05	-	-	-	-	-	-	-	**1.3E-05**
Ethylbenzene	-	2.1E-01	1.7E-05	-	1.4E-02	1.6E-04	0.09	3.6E-04	**0.31**
Ethylene Dibromide	-	-	-	-	-	-	-	3.1E-04	**3.1E-04**
Fluoranthene	3.2E-08	-	-	-	-	-	-	-	**3.2E-08**
Fluorene	3.0E-08	-	-	-	-	-	-	-	**3.0E-08**
Formaldehyde	8.1E-04	-	-	-	-	-	-	0.30	**0.30**
n-Hexane	0.02	27.10	2.2E-03	-	0.14	0.00	15.31	-	**42.57**
Indeno(1,2,3-cd)pyrene	1.9E-08	-	-	-	-	-	-	-	**1.9E-08**
Methanol	-	-	-	-	-	-	-	4.4E-02	**4.4E-02**
Methylene Chloride	-	-	-	-	-	-	-	5.9E-04	**5.9E-04**
Naphthalene	6.5E-06	-	-	-	-	-	-	1.4E-03	**1.4E-03**
PAH	-	-	-	-	-	-	-	2.0E-03	**2.0E-03**
Phenanathrene	1.8E-07	-	-	-	-	-	-	-	**1.8E-07**
Pyrene	5.4E-08	-	-	-	-	-	-	-	**5.4E-08**
Styrene	-	-	-	-	-	-	-	1.7E-04	**1.7E-04**
Toluene	3.7E-05	1.58	1.3E-04	-	3.0E-02	2.1E-05	6.67	8.0E-03	**8.29**
Vinyl Chloride	-	-	-	-	-	-	-	1.0E-04	**1.0E-04**
Xylene	-	0.85	7.1E-05	-	9.7E-02	2.8E-03	0.34	2.8E-03	**1.30**
Total	**0.02**	**35.42**	**2.94E-03**	**0.00**	**0.34**	**0.00**	**24.86**	**0.47**	***61.12***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
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Table B.9. - Summary of Controlled HAP Emissions in Tons per Year

Hazardous Air Pollutant	Separator	Condensate Tanks	Produced Water Tanks	Flare Pilot	Fugitive Leaks	Truck Loading	Produced Gas	Compressor Engines	Total
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	3.6E-04	**3.6E-04**
1,1,2-Trichloroethane	-	-	-	-	-	-	-	2.2E-04	**2.2E-04**
1,3-Butadiene	-	-	-	-	-	-	-	9.6E-03	**9.6E-03**
1,3-Dichloropropene	-	-	-	-	-	-	-	1.8E-04	**1.8E-04**
2-Methylnaphthalene	2.6E-07	-	-	7.0E-09	-	-	-	-	**2.6E-07**
2,2,4-Trimethylpentane	-	0.05	0.00	-	0.04	0.00	0.02	-	**0.11**
3-Methylchloranthrene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
7,12-Dimethylbenz(a)anthracene	1.7E-07	-	-	4.6E-09	-	-	-	-	**1.8E-07**
Acenaphthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Acetaldehyde	-	-	-	-	-	-	-	4.02E-02	**4.02E-02**
Acrolein	-	-	-	-	-	-	-	3.8E-02	**3.8E-02**
Anthracene	2.6E-08	-	-	7.0E-10	-	-	-	-	**2.6E-08**
Benzene	2.3E-05	6.3E-02	5.2E-06	6.1E-07	2.3E-02	3.1E-04	0.03	2.3E-02	**0.13**
Benzo(a)anthracene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(b)fluoranthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(k)fluoranthene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Benzo(a)pyrene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Benzo(g,h,l)perylene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Carbon Tetrachloride	-	-	-	-	-	-	-	2.6E-04	**2.6E-04**
Chlorobenzene	-	-	-	-	-	-	-	1.9E-04	**1.9E-04**
Chloroform	-	-	-	-	-	-	-	2.0E-04	**2.0E-04**
Chrysene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Dibenz(a,h)anthracene	1.3E-08	-	-	3.5E-10	-	-	-	-	**1.3E-08**
Dichlorobenzene	1.3E-05	-	-	3.5E-07	-	-	-	-	**1.3E-05**
Ethylbenzene	-	4.2E-03	3.5E-07	-	1.4E-02	1.6E-04	1.8E-03	3.6E-04	**2.0E-02**
Ethylene Dibromide	-	-	-	-	-	-	-	3.1E-04	**3.1E-04**
Fluoranthene	3.2E-08	-	-	8.7E-10	-	-	-	-	**3.3E-08**
Fluorene	3.0E-08	-	-	8.1E-10	-	-	-	-	**3.1E-08**
Formaldehyde	8.1E-04	-	-	2.2E-05	-	-	-	0.30	**0.30**
n-Hexane	0.02	0.66	4.5E-05	5.2E-04	0.14	0.00	0.39	-	**1.21**
Indeno(1,2,3-cd)pyrene	1.9E-08	-	-	5.2E-10	-	-	-	-	**2.0E-08**
Methanol	-	-	-	-	-	-	-	4.4E-02	**4.4E-02**
Methylene Chloride	-	-	-	-	-	-	-	5.9E-04	**5.9E-04**
Naphthalene	6.5E-06	-	-	1.8E-07	-	-	-	1.4E-03	**1.4E-03**
PAH	-	-	-	-	-	-	-	2.0E-03	**2.0E-03**
Phenanathrene	1.8E-07	-	-	4.9E-09	-	-	-	-	**1.9E-07**
Pyrene	5.4E-08	-	-	1.5E-09	-	-	-	-	**5.5E-08**
Styrene	-	-	-	-	-	-	-	1.7E-04	**1.7E-04**
Toluene	3.7E-05	3.2E-02	2.6E-06	9.9E-07	3.0E-02	2.1E-05	0.13	8.0E-03	**0.20**
Vinyl Chloride	-	-	-	-	-	-	-	1.0E-04	**1.0E-04**
Xylene	-	1.7E-02	1.4E-06	-	9.7E-02	2.8E-03	0.01	2.8E-03	**0.13**
Total	**0.02**	**0.83**	**5.88E-05**	**5.46E-04**	**0.34**	**0.00**	**0.58**	**0.47**	***2.24***

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Most Recent Production Data

Table B.10.a - PetroShale US8H Most Recent Year of Production Data

Month	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared, MCF
August 2019	5,377	1,798	0	0
July 2019	10,479	4,143	18,547	8,468
June 2019	14,908	5,446	26,100	10
May 2019	15,957	6,775	25,826	789
April 2019	16,997	10,371	24,445	2,967
March 2019	2,381	1,737	148	35
February 2019	9,346	1,586	13,089	408
January 2019	11,406	1,985	14,935	46
December 2019	11,919	2,191	16,915	155
November 2018	13,540	2,786	20,861	4,240
October 2018	16,223	3,615	25,952	198
September 2018	16,340	3,504	25,691	465
Daily Average	**396.91**	**125.85**	**582.22**	**48.72**

Table B.10.b - PetroShale US12H Production Data Since Well Completion

Month	Days On	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared [1], MCF
August 2019	8	10,044	3,235	12,743	1,043
September 2019	30	33,122	N/A	41,778	3,496
October 2019	1	945	N/A	1,410	118
Daily Average		**1,131.05**	**404.38**	**1,434.13**	**119.40**
Adjusted Daily Average [2]		**678.63**	**242.63**	**860.48**	**71.64**

[1] Assumed the gas flared would be at the same rate as the US8H well.

[2] Assuming a 40% decline in production for the first year of operation.

Table B.10.c - PetroShale US 13H Production Data Since Well Completion

Date	Oil Produced, BBLs	Water Produced, BBLs	Gas Produced, MSCF	Gas Flared [1], MCF
August 2019	6,580	2,290	0	0
July 2019	0	0	0	0
June 2019	14,289	10,020	29,092	2,434
May 2019	28,139	15,655	68,482	5,730
Daily Average	**418.87**	**239.02**	**833.97**	**69.78**
Adjusted Daily Average [2]	**251.32**	**143.41**	**500.38**	**41.87**

[1] Assumed the gas flared would be at the same rate as the US8H well.

[2] Assuming a 40% decline in production for the first year of operation.

Table B.10.d - Daily Average Production of the Entire Primus Facility (all 3 wells)

Well	Oil Produced Per Day, BBLs	Water Produced Per Day, BBLs	Gas Produced Per Day, MSCF	Gas Flared Per Day, MCF
PetroShale US8H	396.91	125.85	582.22	48.72
PetroShale US12H	678.63	242.63	860.48	71.64
PetroShale US13H	251.32	143.41	500.38	41.87
Total Facility Daily Average	**1,326.87**	**511.89**	**1,943.07**	**162.22**

[1] Assuming a 40% decline in production for the first year of operation.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Separator Burners

Table B.11. - Separator Burner Information

Parameter	Value
Burner Rating (each), MMBtu/hr	1.00
Number of Separator Burners	2
Burner Rating (each), MMBtu/hr	0.50
Number of Separator Burners	1
HHV, Btu/scf	1,535.40
Total Fuel Consumption, Mscf/day	39.08

Note: Fuel HHV from gas analysis dated March 6, 2017. Fuel consumption calculated using:

$$\frac{Mscf}{day} = \left[Burner\ rating, \frac{MMBtu}{hr}\right] \times \left[\frac{10^6 Btu}{MMBtu}\right] \times \left[\frac{24hr}{day}\right] \div \left[HHV, \frac{\mathrm{Btu}}{\mathrm{scf}}\right] \div \left[\frac{1{,}000\ scf}{Mscf}\right]$$

Table B.12. - Separator Burner Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
PM_{10} [1]	7.60	7.45E-03	0.02	0.08
$PM_{2.5}$ [1]	7.60	7.45E-03	0.02	0.08
SO_2	0.60	5.88E-04	1.47E-03	6.44E-03
NO_X	100.00	0.10	0.25	1.07
CO	84.00	0.08	0.21	0.90
VOC	5.50	5.39E-03	0.01	0.06

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Tables 1.4-1 and 1.4-2). Emission factors converted from lb/10^6 scf to lb/MMBtu by dividing by the average heat value of natural gas: 1,020 Btu/scf.

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.13. - Separator Burner Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	2.35E-08	5.88E-08	2.58E-07
3-Methylchloranthrene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.57E-08	3.92E-08	1.72E-07
Acenaphthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Anthracene	2.40E-06	2.35E-09	5.88E-09	2.58E-08
Benz(a)anthracene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Benzene	2.10E-03	2.06E-06	5.15E-06	2.25E-05
Benzo(a)pyrene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Benzo(b)fluoranthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Benzo(g,h,i)perylene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Benzo(k)fluoranthene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Crysene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Dibenzo(a,h)anthracene	1.20E-06	1.18E-09	2.94E-09	1.29E-08
Dichlorobenzene	1.20E-03	1.18E-06	2.94E-06	1.29E-05
Fluoranthene	3.00E-06	2.94E-09	7.35E-09	3.22E-08
Fluorene	2.80E-06	2.75E-09	6.86E-09	3.01E-08
Formaldehyde	7.50E-02	7.35E-05	1.84E-04	8.05E-04
n-Hexane	1.80E+00	1.76E-03	4.41E-03	1.93E-02
Indeno(1,2,3-cd)pyrene	1.80E-06	1.76E-09	4.41E-09	1.93E-08
Naphthalene	6.10E-04	5.98E-07	1.50E-06	6.55E-06
Phenanathrene	1.70E-05	1.67E-08	4.17E-08	1.83E-07
Pyrene	5.00E-06	4.90E-09	1.23E-08	5.37E-08
Toluene	3.40E-03	3.33E-06	8.33E-06	3.65E-05
Total:			**4.61E-03**	**0.02**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3). Emission factors converted from lb/10^6 scf to lb/MMBtu by dividing by the average heat value of natural gas: 1,020 Btu/scf.

Table B.14. - Separator Burner Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emission Rate, lb/hr	Emission Rate, tpy
CO_2	53.06	116.98	292.44	1,280.90
CH_4	1.00E-03	2.20E-03	5.51E-03	0.02
N_2O	1.00E-04	2.20E-04	5.51E-04	2.41E-03
		Total CO_2e:	**292.75**	**1,282.22**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Crude Oil/Condensate Storage Tanks

Table B.15. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Information

Parameter	Value
Tank Vapor Volume, scfm	96.22
Tank Vapor Heating Value, Btu/scf	2,715.46
Total Gas Volume per Hour, MMSCF/hr	0.00577

Note: Tank vapor volume and heating value from E&P Tanks modeling run.

Table B.16. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.45E-03	0.12	0.51
$PM_{2.5}$ [1]	7.60	7.45E-03	0.12	0.51
SO_2	0.60	5.88E-04	0.01	0.04
NO_X	-	0.07	1.07	4.67
CO	-	0.31	4.86	21.29
VOC	5.50	5.39E-03	0.08	0.37

Note: Emission factors for NO_X and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_x\ and\ CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, SO_2, and VOC from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, SO_2, or\ VOC, \frac{lb}{hr} = \left[Total\ gas\ volume, \frac{10^6\ \text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6\ \text{scf}}\right]\ x\ \frac{Produced\ Gas\ heating\ value\ \left[\frac{btu}{scf}\right]}{Average\ NG\ heating\ value\ (1{,}020)\left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.17. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	3.69E-07	1.62E-06
3-Methylchloranthrene	1.80E-06	2.77E-08	1.21E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	2.46E-07	1.08E-06
Acenaphthene	1.80E-06	2.77E-08	1.21E-07
Anthracene	2.40E-06	3.69E-08	1.62E-07
Benz(a)anthracene	1.80E-06	2.77E-08	1.21E-07
Benzene	2.10E-03	3.23E-05	1.41E-04
Benzo(a)pyrene	1.20E-06	1.84E-08	8.08E-08
Benzo(b)fluoranthene	1.80E-06	2.77E-08	1.21E-07
Benzo(g,h,i)perylene	1.20E-06	1.84E-08	8.08E-08
Benzo(k)fluoranthene	1.80E-06	2.77E-08	1.21E-07
Crysene	1.80E-06	2.77E-08	1.21E-07
Dibenzo(a,h)anthracene	1.20E-06	1.84E-08	8.08E-08
Dichlorobenzene	1.20E-03	1.84E-05	8.08E-05
Fluoranthene	3.00E-06	4.61E-08	2.02E-07
Fluorene	2.80E-06	4.30E-08	1.88E-07
Formaldehyde	7.50E-02	1.15E-03	5.05E-03
n-Hexane	1.80E+00	2.77E-02	1.21E-01
Indeno(1,2,3-cd)pyrene	1.80E-06	2.77E-08	1.21E-07
Naphthalene	6.10E-04	9.38E-06	4.11E-05
Phenanathrene	1.70E-05	2.61E-07	1.14E-06
Pyrene	5.00E-06	7.68E-08	3.37E-07
Toluene	3.40E-03	5.23E-05	2.29E-04
Total:		**0.03**	**0.13**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.18. - Crude Oil/Condensate Storage Tank Vapor Sent to Flare Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	1,833.88	8,032.41
CH_4	1.00E-03	2.20E-03	3.46E-02	0.15
N_2O	1.00E-04	2.20E-04	3.46E-03	1.51E-02
		Total CO_2e:	**1,835.78**	**8,040.71**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Crude Oil/Condensate Storage Tanks

Table B.19. - E&P Tank Modeling Results and Percent Total

Parameter	Uncontrolled Emissions E&P Tanks Model Results, tpy			Controlled Emissions E&P Tanks Model Results, tpy		
	Flashing	Working & Breathing	Total	Flashing	Working & Breathing	Total
Total Emissions	629.76	2,464.08	3,093.84	12.60	49.28	61.88
Emissions per Tank	39.36	154.00	193.37	0.79	3.08	3.87
Percent of Total	20.4%	79.6%	100%	20.4%	79.6%	100%

Note: Flashing and working & breathing losses are only provided for uncontrolled emissions in the E&P Tank model. These percentages of the total (20.4% for flashing emissions and 79.6% for working & breathing emissions) were used to estimate emissions for other pollutants (below, in Table B.20).

Table B.20. - Crude Oil/Condensate Storage Tank Emissions

Parameter	Uncontrolled Emissions E&P Tanks Model Results				Controlled Emissions E&P Tanks Model Results, tpy			Controlled Emissions Calculated Tank Vapor	Controlled Emissions Total Emissions		Controlled Emissions Emissions per Tank	
	Flashing	Working & Breathing	Total, lb/hr	Total, tpy	Flashing	Working & Breathing	Total, tpy	Combustion Emissions, tpy	lb/hr	tpy	lb/hr	tpy
VOC	542.77	2,123.71	608.79	2,666.49	10.86	42.47	53.33	0.37	12.26	53.70	0.77	3.36
Total CO_2e	97.76	382.51	109.65	480.27	2.73	10.67	13.39	8,040.71	1,838.84	8,054.10	114.93	503.38
CH_4	3.88	15.18	4.35	19.06	0.08	0.30	0.38	0.15	0.12	0.53	0.01	0.03
CO_2	0.79	3.08	0.88	3.87	0.79	3.08	3.87	8,032.41	1,834.77	8,036.28	114.67	502.27
N_2O	-	-	-	-	-	-	-	0.02	3.46E-03	0.02	2.16E-04	9.46E-04
Total HAPs	7.21	28.21	8.09	35.42	0.14	0.56	0.71	0.13	0.19	0.84	0.01	0.05
Benzene	0.63	2.48	0.71	3.12	0.01	0.05	0.06	1.41E-04	0.01	0.06	8.92E-04	3.91E-03
Toluene	0.32	1.26	0.36	1.58	0.01	0.03	0.03	2.29E-04	0.01	0.03	4.55E-04	1.99E-03
Ethylbenzene	0.04	0.17	0.05	0.21	8.47E-04	3.31E-03	4.16E-03	-	9.50E-04	4.16E-03	5.94E-05	2.60E-04
Xylene	0.17	0.68	0.19	0.85	3.47E-03	0.01	0.02	-	3.89E-03	0.02	2.43E-04	1.07E-03
n-C6	5.52	21.58	6.19	27.10	0.11	0.43	0.54	0.12	0.15	0.66	0.01	0.04
2,2,4-Trimethylpentane	0.52	2.04	0.58	2.56	0.01	0.04	0.05	-	0.01	0.05	7.30E-04	3.20E-03
H_2S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00
PM_{10}	-	-	-	-	-	-	-	0.51	0.12	0.51	0.01	0.03
$PM_{2.5}$	-	-	-	-	-	-	-	0.51	0.12	0.51	0.01	0.03
SO_2	-	-	-	-	-	-	-	0.04	0.01	0.04	5.76E-04	2.52E-03
NO_X	-	-	-	-	-	-	-	4.67	1.07	4.67	0.07	0.29
CO	-	-	-	-	-	-	-	21.29	4.86	21.29	0.30	1.33

Note: Uncontrolled and controlled emissions from E&P Tank model run using the oil analysis dated March 6, 2017, included in this appendix. Assumed 98% control efficiency for the flare. Flashing and working & breathing losses estimated for the pollutants above as a percentage of their total emissions (see Table B.19). For example, total uncontrolled flashing emissions was equal to 20.4% of total uncontrolled emissions. Therefore, for VOC, flashing emissions are 20.4% of total uncontrolled VOC emissions. Emissions in pounds per hour assumed to occur over 8,760 hours per year.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Produced Water Tanks

Table B.21. - Produced Water Tanks Emissions

Pollutant	Uncontrolled Emissions		Controlled Emissions	
	lb/hr	tpy	lb/hr	tpy
VOC	0.06	0.26	1.17E-03	5.14E-03
Total CO_2e	0.01	0.06	3.84E-03	0.02
CH_4	3.61E-04	1.58E-03	7.22E-06	3.16E-05
CO_2	3.66E-03	0.02	3.66E-03	0.02
Total HAPs	6.71E-04	2.94E-03	1.34E-05	5.88E-05
Benzene	5.91E-05	2.59E-04	1.18E-06	5.18E-06
Toluene	3.00E-05	1.31E-04	6.00E-07	2.63E-06
Ethylbenzene	3.94E-06	1.73E-05	7.88E-08	3.45E-07
Xylene	1.62E-05	7.08E-05	3.23E-07	1.42E-06
n-C6	5.14E-04	2.25E-03	1.03E-05	4.50E-05
2,2,4-Trimethylpentane	4.85E-05	2.12E-04	9.69E-07	4.25E-06
H_2S	0.00	0.00	0.00	0.00

Note: Produced water tank emissions from EPA TANKS modeling run. Speciated HAPs are assumed to have the same proportion of emissions (HAP to VOC) as the crude oil/ condensate storage tanks. Assumed 98% control efficiency for the flare. Emissions in pounds per hour assumed to occur over 8,760 hours per year.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Steffes Engineered Flare Pilot

Table B.22. - Steffes Engineered Flare Pilot Information

Parameter	Value
Flare Pilot Usage, hours	8,760
Number of Flares	4
Flare Pilot Gas, scfm	0.2
Flare Pilot Gas Heating Value, Btu/scf	1,535.4
Total Gas Volume per Hour per Flare, MMSCF/hr	0.00001
Flare Control Efficiency	98%

Note: Flare pilot gas conservatively assumed and gas heating value is averaged from a produced gas analysis dated March 6, 2017.

Table B.23. - Steffes Engineered Flare Pilot Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.45E-03	5.03E-04	2.20E-03
$PM_{2.5}$ [1]	7.60	7.45E-03	5.03E-04	2.20E-03
SO_2	0.60	5.88E-04	3.97E-05	1.74E-04
NO_X	-	0.07	4.59E-03	2.01E-02
CO	-	0.31	0.02	9.17E-02
VOC	5.50	5.39E-03	3.64E-04	1.60E-03

Note: Emission factors for NO_X and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_X\ and\ CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, SO_2, and VOC from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, SO_2, or\ VOC, \frac{lb}{hr} = \left[Total\ gas\ volume, \frac{10^6\ \text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6\ \text{scf}}\right]\ x\ \frac{Produced\ Gas\ heating\ value\ \left[\frac{btu}{scf}\right]}{Average\ NG\ heating\ value\ (1{,}020)\left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.24. - Steffes Engineered Flare Pilot Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	1.59E-09	6.96E-09
3-Methylchloranthrene	1.80E-06	1.19E-10	5.22E-10
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.06E-09	4.64E-09
Acenaphthene	1.80E-06	1.19E-10	5.22E-10
Anthracene	2.40E-06	1.59E-10	6.96E-10
Benz(a)anthracene	1.80E-06	1.19E-10	5.22E-10
Benzene	2.10E-03	1.39E-07	6.09E-07
Benzo(a)pyrene	1.20E-06	7.95E-11	3.48E-10
Benzo(b)fluoranthene	1.80E-06	1.19E-10	5.22E-10
Benzo(g,h,i)perylene	1.20E-06	7.95E-11	3.48E-10
Benzo(k)fluoranthene	1.80E-06	1.19E-10	5.22E-10
Crysene	1.80E-06	1.19E-10	5.22E-10
Dibenzo(a,h)anthracene	1.20E-06	7.95E-11	3.48E-10
Dichlorobenzene	1.20E-03	7.95E-08	3.48E-07
Fluoranthene	3.00E-06	1.99E-10	8.70E-10
Fluorene	2.80E-06	1.85E-10	8.12E-10
Formaldehyde	7.50E-02	4.97E-06	2.18E-05
n-Hexane	1.80E+00	1.19E-04	5.22E-04
Indeno(1,2,3-cd)pyrene	1.80E-06	1.19E-10	5.22E-10
Naphthalene	6.10E-04	4.04E-08	1.77E-07
Phenanathrene	1.70E-05	1.13E-09	4.93E-09
Pyrene	5.00E-06	3.31E-10	1.45E-09
Toluene	3.40E-03	2.25E-07	9.86E-07
Total:		**1.25E-04**	**5.46E-04**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.25. - Steffes Engineered Flare Pilot Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	7.90	34.61
CH_4	1.00E-03	2.20E-03	1.49E-04	6.52E-04
N_2O	1.00E-04	2.20E-04	1.49E-05	6.52E-05
		Total CO_2e:	**7.91**	**34.65**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298,

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Fugitive Leaks

Table B.26. - Fugitive Emissions: Emission Factors for Total Hydrocarbon (THC) Emissions

Equipment Type	Equipment Service Category, lb/hr/source			
	Gas	Heavy Oil (< 20° API)	Light Oil (>20° API)	Water/Light Oil
Valves	9.92E-03	1.85E-05	5.51E-03	2.16E-04
Pump Seals	5.29E-03	-	2.87E-02	5.29E-05
Others	1.94E-02	7.05E-05	1.65E-02	3.09E-02
Connectors	4.41E-04	1.65E-05	4.63E-04	2.43E-04
Flanges	8.60E-04	8.60E-07	2.43E-04	6.39E-06
Open-Ended Lines	4.41E-03	3.09E-04	3.09E-03	5.51E-04

Note: From US EPA Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017). Emission factors converted from kg/source-hr to lb/source-hr The water/light oil emission factors apply to water streams in light oil service with water content between 50% and 99%. For streams with water content > 99%, the emission rate is considered negligible. The "other" equipment type includes compressor, pressure relief valves, diaphragms, drains, dump arms, hatches, instruments, meters, polished rods, and vents.

Table B.27. - Fugitive THC Emissions

Equipment Type	Number of Components	Service	Emission Factor, lb/hr/source	THC Emissions, lb/hr	THC Emissions, tpy
Valves	78	Gas	9.92E-03	0.77	3.39
Valves	78	Light Oil	5.51E-03	0.43	1.88
Valves	8	Water/Light Oil	2.16E-04	1.73E-03	0.01
Pump Seals	0	Gas	5.29E-03	0.00	0.00
Pump Seals	0	Light Oil	2.87E-02	0.00	0.00
Pump Seals	0	Water/Light Oil	5.29E-05	0.00	0.00
Others	0	Gas	1.94E-02	0.00	0.00
Others	0	Light Oil	1.65E-02	0.00	0.00
Others	0	Water/Light Oil	3.09E-02	0.00	0.00
Connectors	672	Gas	4.41E-04	0.30	1.30
Connectors	354	Light Oil	4.63E-04	0.16	0.72
Connectors	52	Water/Light Oil	2.43E-04	0.01	0.06
Flanges	4	Gas	8.60E-04	3.44E-03	0.02
Flanges	0	Light Oil	2.43E-04	0.00	0.00
Flanges	0	Water/Light Oil	6.39E-06	0.00	0.00
Open-Ended Lines	0	Gas	4.41E-03	0.00	0.00
Open-Ended Lines	0	Light Oil	3.09E-03	0.00	0.00
Open-Ended Lines	0	Water/Light Oil	5.51E-04	0.00	0.00
			Total THC Emissions:	**1.68**	**7.38**

Note: Number of components estimated from actual counts performed at similar facilities.

Table B.28. - Speciated Fugitive Emission Factors

Pollutant	Weight Fraction	Weight Fraction	Weight Fraction	Emissions, lb/hr	Emissions, tpy
	Gas	Light Oil	Water/Light Oil		
THC	1.00	1.00	1.00	1.68	7.37
VOC	0.84	1.00	1.00	1.51	6.61
Total CO_2e	-	-	-	0.19	0.85
CH_4	7.20E-03	0.00	0.00	0.01	0.03
CO_2	1.46E-03	0.00	0.00	1.57E-03	0.01
Total HAPs	1.23E-02	0.11	0.11	0.08	0.34
Benzene	1.05E-03	6.64E-03	6.64E-03	0.01	0.02
Toluene	7.08E-05	1.12E-02	1.12E-02	0.01	0.03
Ethylbenzene	5.35E-04	4.16E-03	4.16E-03	3.10E-03	0.01
Xylenes	9.43E-03	1.99E-02	1.99E-02	0.02	0.10
n-Hexane	2.76E-04	5.14E-02	5.14E-02	0.03	0.14
2,2,4-Trimethylpentane	9.12E-04	1.18E-02	1.18E-02	0.01	0.04
H_2S	0.00	0.00	0.00	0.00	0.00

Note: Water/Light Oil and Light Oil Weight fractions based on E&P Tank modeling run flashed gas results for the oil storage tanks. All stream weight fractions for organic compounds used in calculations are normalized based on 100% THC since EPA emission factors are based on THC emission rate. Produced gas speciated HAPs are proportionally based on the speciated HAPs in the E&P TANK v2.0 flashed gas results, then normalized based on 100% THC.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Truck Loading

Table B.29. - Truck Loading Emissions Calculation Inputs - Produced Water Only

Parameter	Value
Saturation Factor (S)	0.6
True Vapor Pressure of Liquid Loaded (P), psia	0.24
Molecular Weight of Vapors (M), lb/lb-mole	20.68
Temperature of Bulk Liquid Loaded (T), °F	41.45
Loading Losses, lb/1,000 gallons	**0.08**
Water Production, BPD	511.9
Average Water Loadout Rate, gallons/hr	895.8
Maximum Water Loadout Rate, gallons/hr	7,560.0
Maximum Yearly Throughput, gallons/yr	7,847,274

Note: Loading losses based on EPA AP-42 Section 5.2-4:

$$L_L = 12.46 \frac{SPM}{(T + 460)}$$

Saturation factor based on submerged loading: dedicated normal service. Molecular weight of vapors and liquid bulk temperature from EPA Tank run. TVP of liquid loaded is assumed to be the maximum vapor pressure from hottest month (July) to be conservative.

Table B.30. - Truck Loading Emissions in Tons Per Year

Pollutant	Weight Fraction	Produced Water Loading	
		lb/hr	tpy
THC	1.00	0.57	0.29
VOC	0.84	0.48	0.25
Total CO_2e	-	0.10	0.05
CH_4	7.20E-03	4.08E-03	2.12E-03
CO_2	1.46E-03	8.28E-04	4.29E-04
Total HAPs	1.23E-02	0.01	3.61E-03
Benzene	1.05E-03	5.97E-04	3.10E-04
Toluene	7.08E-05	4.02E-05	2.08E-05
Ethylbenzene	5.35E-04	3.03E-04	1.57E-04
Xylenes	9.43E-03	0.01	2.78E-03
n-Hexane	2.76E-04	1.57E-04	8.13E-05
2,2,4-Trimethylpentane	9.12E-04	5.17E-04	2.68E-04
H_2S	0.00	0.00	0.00

Note: Weight fractions based on E&P Tank modeling run working and breathing gas composition for the crude oil/condensate storage tanks, which is included in this appendix. Truck loading emissions in lb/hr use maximum loadout rate. Note that crude oil/condensate is removed from site via pipeline so no loading emissions for crude oil/condensate are calculated.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Compressor Engine 1

Table B.31. - Engine Information

Parameter	Value
Engine #1 Horsepower (hp)	400
Number of Units	1
Fuel	Natural Gas
Annual Hours of Operation per Unit (hr)	8,760
Fuel Heat Rating (Btu/hr) [1]	3,290,000
Maximum Heat Input (MMBtu/hr)	3.29
Fuel Specific HHV (Btu/scf)	1,020
Fuel Use Rate (scf/hr)	3,225.49
Annual Fuel Consumption (MMBtu/year)	28,820.40
Annual Fuel Consumption (MMSCF/year)	28.26

[1] Values from engine manufacturer's specifications.

Table B.32. - Uncontrolled Compressor Engine Emissions

Component	Uncontrolled Emission Factor [1]		Uncontrolled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	26.27	23.17	101.47
CO	-	1.60	1.41	6.18
VOCs	-	0.16	0.14	0.62
Formaldehyde	2.05E-02	-	6.74E-02	0.30
$PM_{2.5}$	9.50E-03	-	3.13E-02	0.14
PM_{10}	9.50E-03	-	3.13E-02	0.14
PM	9.10E-03	-	2.99E-02	0.13
SO_2	5.88E-04	-	1.93E-03	0.01
CH_4	0.23	-	0.76	3.31
N_2O	1.32E-03	-	4.35E-03	0.02
CO_2	110.00	-	361.90	1,585.12
CO_2e [2]	110.00	-	382.11	1,673.66

[1] The emission factors for CO, NOx, and VOC are based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Table B.33. - Controlled Compressor Engine Emissions

Component	Controlled Emission Factor [1]		Controlled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	1.00	0.88	3.86
CO	-	2.00	1.76	7.72
VOCs	-	0.70	0.62	2.70
Formaldehyde	2.05E-02	-	6.74E-02	0.30
$PM_{2.5}$	9.50E-03	-	3.13E-02	0.14
PM_{10}	9.50E-03	-	3.13E-02	0.14
PM	9.10E-03	-	2.99E-02	0.13
SO_2	5.88E-04	-	1.93E-03	0.01
CH_4	0.23	-	0.76	3.31
N_2O	1.32E-03	-	4.35E-03	0.02
CO_2	-	459.00	404.77	1,772.89
CO_2e [2]	-	-	424.98	1,861.43

[1] The emission factors for CO, NOx, and VOC are based on the gram per brake-horsepower-hour (g/bhp-hr) uncontrolled rates. Engines would meet the emission standards of NSPS JJJJ for Non-Emergency Natural Gas Engines. The emission factor CO_2 is based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Compressor Engine 1

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

Table B.34. - Compressor Engine HAP Emissions

Component	AP-42 Emission Factor [1] lb/MMBtu	Uncontrolled Emission Rate lb/hr	Uncontrolled Emission Rate tons/year	Controlled Emission Rate lb/hr	Controlled Emission Rate tons/year
1,1,2,2-Tetrachloroethane	2.53E-05	8.32E-05	3.65E-04	8.32E-05	3.65E-04
1,1,2-Trichloroethane	1.53E-05	5.03E-05	2.20E-04	5.03E-05	2.20E-04
1,3-Butadiene	6.63E-04	2.18E-03	9.55E-03	2.18E-03	9.55E-03
1,3-Dichloropropene	1.27E-05	4.18E-05	1.83E-04	4.18E-05	1.83E-04
Acetaldehyde	2.79E-03	9.18E-03	4.02E-02	9.18E-03	4.02E-02
Acrolein	2.63E-03	8.65E-03	3.79E-02	8.65E-03	3.79E-02
Benzene	1.58E-03	5.20E-03	2.28E-02	5.20E-03	2.28E-02
Carbon Tetrachloride	1.77E-05	5.82E-05	2.55E-04	5.82E-05	2.55E-04
Chlorobenzene	1.29E-05	4.24E-05	1.86E-04	4.24E-05	1.86E-04
Chloroform	1.37E-05	4.51E-05	1.97E-04	4.51E-05	1.97E-04
Ethylbenzene	2.48E-05	8.16E-05	3.57E-04	8.16E-05	3.57E-04
Ethylene Dibromide	2.13E-05	7.01E-05	3.07E-04	7.01E-05	3.07E-04
Methanol	3.06E-03	1.01E-02	4.41E-02	1.01E-02	4.41E-02
Methylene Chloride	4.12E-05	1.36E-04	5.94E-04	1.36E-04	5.94E-04
Naphthalene	9.71E-05	3.19E-04	1.40E-03	3.19E-04	1.40E-03
PAH	1.41E-04	4.64E-04	2.03E-03	4.64E-04	2.03E-03
Styrene	1.19E-05	3.92E-05	1.71E-04	3.92E-05	1.71E-04
Toluene	5.58E-04	1.84E-03	8.04E-03	1.84E-03	8.04E-03
Vinyl Chloride	7.18E-06	2.36E-05	1.03E-04	2.36E-05	1.03E-04
Xylene	1.95E-04	6.42E-04	2.81E-03	6.42E-04	2.81E-03
Total HAPs [2]	**3.24E-02**	**0.11**	**0.47**	**0.11**	**0.47**

[1] Emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

[2] Total HAPs emissions include formaldehyde emissions from Tables B.32 and B.33.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Compressor Engine 2

Table B.35. - Engine Information

Parameter	Value
Engine #2 Horsepower (hp)	215
Number of Units	1
Fuel	Natural Gas
Annual Hours of Operation per Unit (hr)	8,760
Fuel Heat Rating (Btu/hr) [1]	1,669,905
Maximum Heat Input (MMBtu/hr)	1.67
Fuel Specific HHV (Btu/scf)	1,020
Fuel Use Rate (scf/hr)	1,637.16
Annual Fuel Consumption (MMBtu/year)	14,628.37
Annual Fuel Consumption (MMSCF/year)	14.34

[1] Values from engine manufacturer's specifications.

Table B.36. - Uncontrolled Compressor Engine Emissions

Component	AP-42 Emission Factor [1]		Uncontrolled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	27.94	13.24	58.01
CO	-	1.40	0.66	2.91
VOCs	-	0.18	0.09	0.37
Formaldehyde	2.05E-02	-	3.42E-02	0.15
$PM_{2.5}$	0.0095	-	1.59E-02	0.07
PM_{10}	0.0095	-	1.59E-02	0.07
PM	0.0091	-	1.52E-02	0.07
SO_2	0.000588	-	9.82E-04	4.30E-03
CH_4	0.23	-	0.38	1.68
N_2O	1.32E-03	-	2.21E-03	0.01
CO_2	110.00	-	183.69	804.56
CO_2e [2]	110.00	-	193.95	849.50

[1] The emission factors for CO, NOx, and VOC are based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Table B.37. - Controlled Compressor Engine Emissions

Component	Controlled Emission Factor [1]		Controlled Emission Rate	
	lb/MMBtu	g/bhp-hr	lb/hr	tons/year
NO_X	-	1.00	0.47	2.08
CO	-	2.00	0.95	4.15
VOCs	-	0.70	0.33	1.45
Formaldehyde	2.05E-02	-	3.42E-02	0.15
$PM_{2.5}$	9.50E-03	-	1.59E-02	0.07
PM_{10}	9.50E-03	-	1.59E-02	0.07
PM	9.10E-03	-	1.52E-02	0.07
SO_2	5.88E-04	-	9.82E-04	4.30E-03
CH_4	0.23	-	0.38	1.68
N_2O	1.32E-03	-	2.21E-03	0.01
CO_2	-	511.00	242.21	1,060.88
CO_2e [2]	-	511.00	252.47	1,105.82

[1] The emission factors for CO, NOx, and VOC are based on the gram per brake-horsepower-hour (g/bhp-hr) uncontrolled rates. Engines would meet the emission standards of NSPS JJJJ for Non-Emergency Natural Gas Engines. The emission factor CO_2 is based on the manufacturer's specifications. All other emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Compressor Engine 2

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

[2] Global warming potentials obtained from Table A-1 to Subpart 98 - Global Warming Potentials Equation A-1: $CO_2e = \sum GHGi \times GWPi$
Where:
CO_2e = Carbon dioxide equivalent (tons/year)
GHGi = Mass emissions of each GHG (tons/year)
GWPi = Global warming potential for each GHG (1 for CO_2; 25 for CH_4; 298 for N_2O)

Table B.38. - Compressor Engine HAP Emissions

Component	AP-42 Emission Factor [1]	Uncontrolled Emission Rate		Controlled Emission Rate	
	lb/MMBtu	lb/hr	tons/year	lb/hr	tons/year
1,1,2,2-Tetrachloroethane	2.53E-05	4.22E-05	1.85E-04	4.22E-05	1.85E-04
1,1,2-Trichloroethane	1.53E-05	2.55E-05	1.12E-04	2.55E-05	1.12E-04
1,3-Butadiene	6.63E-04	1.11E-03	4.85E-03	1.11E-03	4.85E-03
1,3-Dichloropropene	1.27E-05	2.12E-05	9.29E-05	2.12E-05	9.29E-05
Acetaldehyde	2.79E-03	4.66E-03	2.04E-02	4.66E-03	2.04E-02
Acrolein	2.63E-03	4.39E-03	1.92E-02	4.39E-03	1.92E-02
Benzene	1.58E-03	2.64E-03	1.16E-02	2.64E-03	1.16E-02
Carbon Tetrachloride	1.77E-05	2.96E-05	1.29E-04	2.96E-05	1.29E-04
Chlorobenzene	1.29E-05	2.15E-05	9.44E-05	2.15E-05	9.44E-05
Chloroform	1.37E-05	2.29E-05	1.00E-04	2.29E-05	1.00E-04
Ethylbenzene	2.48E-05	4.14E-05	1.81E-04	4.14E-05	1.81E-04
Ethylene Dibromide	2.13E-05	3.56E-05	1.56E-04	3.56E-05	1.56E-04
Methanol	3.06E-03	5.11E-03	2.24E-02	5.11E-03	2.24E-02
Methylene Chloride	4.12E-05	6.88E-05	3.01E-04	6.88E-05	3.01E-04
Naphthalene	9.71E-05	1.62E-04	7.10E-04	1.62E-04	7.10E-04
PAH	1.41E-04	2.35E-04	1.03E-03	2.35E-04	1.03E-03
Styrene	1.19E-05	1.99E-05	8.70E-05	1.99E-05	8.70E-05
Toluene	5.58E-04	9.32E-04	4.08E-03	9.32E-04	4.08E-03
Vinyl Chloride	7.18E-06	1.20E-05	5.25E-05	1.20E-05	5.25E-05
Xylene	1.95E-04	3.26E-04	1.43E-03	3.26E-04	1.43E-03
Total HAPs [2]	**3.24E-02**	**5.41E-02**	**0.24**	**5.41E-02**	**0.24**

[1] Emission factors from AP-42 Chapter 3 Section 2, Table 3.2-3.

[2] Total HAPs emissions include formaldehyde emissions from Tables B.36 and B.37.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Produced Gas

Table B.39. - Produced Gas Sent to Flare Information

Parameter	Value
Produced Gas Volume, MCFD	162.22
Produced Gas Volume, scf/hr	6,759.29
Produced Gas Heating Value, Btu/scf	1,535.40
Total Gas Volume per Hour, 10^6 scf/hr	0.01

Note: The wells are connected to a gas sales pipeline. The flared gas volumes for the US12H and US13H wells are based on the percentage of gas flared for the US8H well. Heating value based on gas analysis dated March 6, 2017 (included in this appendix).

Table B.40. - Produced Gas Sent to Flare Criteria Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
PM_{10} [1]	7.60	7.451E-03	0.08	0.34
$PM_{2.5}$ [1]	7.60	7.451E-03	0.08	0.34
SO_2	0.60	5.882E-04	0.01	0.03
NO_X	-	0.07	0.71	3.09
CO	-	0.31	3.22	14.09
VOC	5.50	5.392E-03	0.06	0.25

Note: SO_2 and VOC emissions are calculated using fuel in Table B.36. Emission factors for NOX and CO from AP-42, Section 13.5, Industrial Flares, Table 13.5-1, and calculated using the equation below:

$$NO_x \; and \; CO, \frac{lb}{hr} = \left[HHV, \frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{\text{scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{\text{MMBtu}}\right] \times \left[\frac{\text{MMBtu}}{10^6 Btu}\right]$$

Emission factors for PM_{10}, $PM_{2.5}$, VOC, and SO_2 from AP-42, Section 1.4, Natural Gas Combustion, Table 1.4-2, calculated using the equation below:

$$PM_{10}, PM_{2.5}, \frac{lb}{hr} = \left[Total \; gas \; volume, \frac{10^6 \text{ scf}}{\text{hr}}\right] \times \left[EF, \frac{\text{lb}}{10^6 \text{ scf}}\right] \; x \; \frac{Produced \; Gas \; heating \; value \; \left[\frac{btu}{scf}\right]}{Average \; NG \; heating \; value \; (1{,}020) \left[\frac{btu}{scf}\right]}$$

[1] PM_{10} and $PM_{2.5}$ are assumed to equal total particulate matter.

Table B.41. - Produced Gas Sent to Flare Hazardous Air Pollutant Emissions

Pollutant	Emission Factor, lb/10^6 scf	Emission Rate, lb/hr	Emission Rate, tpy
2-Methylnaphthalene	2.40E-05	2.44E-07	1.07E-06
3-Methylchloranthrene	1.80E-06	1.83E-08	8.02E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.63E-07	7.13E-07
Acenaphthene	1.80E-06	1.83E-08	8.02E-08
Anthracene	2.40E-06	2.44E-08	1.07E-07
Benz(a)anthracene	1.80E-06	1.83E-08	8.02E-08
Benzene	2.10E-03	2.14E-05	9.36E-05
Benzo(a)pyrene	1.20E-06	1.22E-08	5.35E-08
Benzo(b)fluoranthene	1.80E-06	1.83E-08	8.02E-08
Benzo(g,h,i)perylene	1.20E-06	1.22E-08	5.35E-08
Benzo(k)fluoranthene	1.80E-06	1.83E-08	8.02E-08
Crysene	1.80E-06	1.83E-08	8.02E-08
Dibenzo(a,h)anthracene	1.20E-06	1.22E-08	5.35E-08
Dichlorobenzene	1.20E-03	1.22E-05	5.35E-05
Fluoranthene	3.00E-06	3.05E-08	1.34E-07
Fluorene	2.80E-06	2.85E-08	1.25E-07
Formaldehyde	7.50E-02	7.63E-04	3.34E-03
n-Hexane	1.80E+00	1.83E-02	8.02E-02
Indeno(1,2,3-cd)pyrene	1.80E-06	1.83E-08	8.02E-08
Naphthalene	6.10E-04	6.21E-06	2.72E-05
Phenanathrene	1.70E-05	1.73E-07	7.58E-07
Pyrene	5.00E-06	5.09E-08	2.23E-07
Toluene	3.40E-03	3.46E-05	1.52E-04
Total:		**0.02**	**0.08**

Note: Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Table 1.4-3).

Table B.42. - Produced Gas Sent to Flare Greenhouse Gas Emissions

Pollutant	Emission Factor, kg/MMBtu	Emission Factor, lb/MMBtu	Emissions, lb/hr	Emissions, tpy
CO_2	53.06	116.98	1,214.02	5,317.39
CH_4	1.00E-03	2.20E-03	0.02	0.10
N_2O	1.00E-04	2.20E-04	0.00	0.01
		Total CO_2e:	**1,215.27**	**5,322.88**

Note: Emission factors from 40 CFR Part 98 Subpart C, Table C-1 and C-2. Converted from kilograms to pounds. Global warming potentials for CH_4 and N_2O are 25 and 298, respectively.

Petroshale (US), Inc.
Primus Facility: PetroShale US 8H, US12H, & US 13H Production Facility
Actual Emission Calculations
Produced Gas

Table B.43. - Flare and Produced Gas Information

Parameter	Value
Flare Destruction Efficiency, %	98
Specific Gravity of Produced Gas	0.92
Molecular Weight of Produced Gas, lb/lb-mole	26.53
HHV of Produced Gas, Btu/scf	1,535.40
Volume of Produced Gas to Flare, MCFD	162.22
Volume of Produced Gas to Flare, scf/hr	6,759.29

Note: Heating value based on gas analysis dated March 6, 2017 (included in this appendix). Molecular weight of gas calculated by multiplying the specific gravity by the molecular weight of air (28.96443 lb/lb-mole).

Table B.44. - Uncontrolled and Controlled Produced Gas Emissions

Pollutant	Gas Analysis Data		Uncontrolled		Controlled		Calculated Combustion Emissions, tpy	Total Controlled Emissions	
	Weight Percent	Mole Percent	lb/hr	tpy	lb/hr	tpy		lb/hr	tpy
VOC	37.76	-	178.69	782.65	3.57	15.65	0.25	3.63	15.90
Total CO_2e	-	-	4,066.53	17,811.42	86.20	377.56	5,322.88	1,301.47	5,700.44
CH_4	34.33	-	162.46	711.59	3.25	14.23	0.10	3.27	14.33
CO_2	1.05	-	4.97	21.77	4.97	21.77	5,317.39	1,218.99	5,339.16
N_2O	-	-	-	-	-	-	0.01	2.29E-03	0.01
Total HAPs	0.74	-	3.50	15.31	0.07	0.31	0.08	0.09	0.39
Benzene	0.06	-	0.30	1.31	0.01	0.03	9.36E-05	0.01	0.03
Toluene	0.32	-	1.52	6.67	0.03	0.13	1.52E-04	0.03	0.13
Ethylbenzene	4.26E-03	-	0.02	0.09	4.03E-04	1.77E-03	-	4.03E-04	1.77E-03
Xylene	0.02	-	0.08	0.34	1.57E-03	0.01	-	1.57E-03	0.01
n-C6	0.74	-	3.50	15.31	0.07	0.31	0.08	0.09	0.39
2,2,4-Trimethylpentane	0.05	-	0.26	1.14	0.01	0.02	-	0.01	0.02
H_2S	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM_{10}	-	-	-	-			0.34	0.08	0.34
$PM_{2.5}$	-	-	-	-			0.34	0.08	0.34
SO_2	-	-	-	-			0.03	0.01	0.03
NO_X	-	-	-	-			3.09	0.71	3.09
CO	-	-	-	-			14.09	3.22	14.09

Note: Speciated HAPs are proportionally based on the speciated HAPs in the E&P TANK v2.0 flashed gas results. Emission factors for NO_X and CO from AP-42, Chapter 13.5, Industrial Flares, Table 13.5-1. Emissions in tons per year assume flaring 8,760 hours per year. Uncontrolled emissions for VOC, HAPs, and H_2S were calculated using the following equation:

$$VOC, HAPs, and\ H_2S\ uncontrolled\ emission\ rate, \frac{lb}{hr} = Molecular\ weight, \frac{\text{lb}}{\text{lb}-\text{mole}} \times \frac{1\ \text{lb}-\text{mole}}{379\ \text{scf}} \times Volume\ of\ gas, \frac{\text{scf}}{\text{hr}} \times Weight\ Percent$$

APPENDIX C

Supporting Documentation

QUESTAR ENERGY SERVICES

1210 D. Street, Rock Springs, Wyoming 82901

(307) 352-7292

LIMS ID:	N/A		Description:	US 8H
Analysis Date/Time:	3/6/2017	12:57 PM	Field:	Mckenzie
Analyst Initials:	JFL		ML#:	Petro Shale
Sample Temperature:	89		GC Method:	Quesliql GPA 2186
Sample Pressure:	32		Data File:	QPC21.D
Date Sampled:	3/2/2017		Instrument ID:	1

Component	Mol%	Wt%	LV%
Methane	0.2204	0.0316	0.0747
Ethane	2.4328	0.6532	1.3013
Propane	6.2208	2.4495	3.4279
Isobutane	1.6599	0.8615	1.0864
n-Butane	7.7361	4.0153	4.8783
Neopentane	0.0321	0.0207	0.0246
Isopentane	3.0908	1.9913	2.2609
n-Pentane	6.2262	4.0114	4.5141
2,2-Dimethylbutane	0.0446	0.0343	0.0373
2,3-Dimethylbutane	0.6316	0.4861	0.5178
2-Methylpentane	2.2666	1.7442	1.8818
3-Methylpentane	1.3808	1.0626	1.1271
n-Hexane	4.5613	3.5100	3.7516
Heptanes	15.1972	13.0228	12.6496
Octanes	9.5641	9.5415	9.2495
Nonanes	8.8266	9.6931	9.1966
Decanes plus	29.8220	46.8471	43.9999
Nitrogen	0.0686	0.0172	0.0151
Carbon Dioxide	0.0163	0.0064	0.0056
Total	100.0000	100.0000	100.0000

Calculated Global Properties		**Units**
Avg Molecular Weight	111.9861	gm/mole
Pseudocritical Pressure	414.46	psia
Pseudocritical Temperatu	524.50	degF
Specific Gravity	0.70979	gm/ml
Liquid Density	5.9174	lb/gal
Liquid Density	248.53	lb/bbl
Specific Gravity	2.7078	air=1
SCF/bbl	844.11	SCF/bbl
SCF/gal	20.0979	SCF/gal
MCF/gal	0.0201	MCF/gal
gal/MCF	49.778	gal/MCF
Net Heating Value	3917.1	BTU/SCF at 60°F
Net Heating Value	13188.4	BTU/lb at 60°F
Gross Heating Value	4239.2	BTU/SCF at 60°F
Gross Heating Value	14244.7	BTU/lb at 60°F
Gross Heating Value	82736.7	BTU/gal at 60°F
API Gravity	67.9	
MON	46.2	
RON	47.7	
TVP	53.646	psia

Component	Mol%	Wt%	LV%
Benzene	0.5895	0.4112	0.3299
Toluene	0.9843	0.8098	0.6592
Ethylbenzene	0.3646	0.3457	0.2814
M&P Xylene	1.3430	1.2732	1.0401
O-Xylene	0.4030	0.3821	0.3066
2,2,4-Trimethylpentane	1.0350	1.0558	1.0404

Data File: US 8H

GRI E&P TANK INFORMATION

Component	Mol%	Wt%	LV%
H2S	ND	ND	ND
O2	ND	ND	ND
CO2	0.0163	0.0064	0.0056
N2	0.0686	0.0172	0.0151
C1	0.2204	0.0316	0.0747
C2	2.4328	0.6532	1.3013
C3	6.2208	2.4495	3.4279
IC4	1.6599	0.8615	1.0864
NC4	7.7682	4.0360	4.9029
IC5	3.0908	1.9913	2.2609
NC5	6.2262	4.0114	4.5141
Hexanes	4.3236	3.3272	3.5640
Heptanes	14.6077	12.6116	12.3197
Octanes	7.5448	7.6759	7.5499
Nonanes	6.7160	7.6921	7.5685
Benzene	0.5895	0.4112	0.3299
Toluene	0.9843	0.8098	0.6592
E-Benzene	0.3646	0.3457	0.2814
Xylene	1.7460	1.6553	1.3467
n-C6	4.5613	3.5100	3.7516
2,2,4-Trimethylpentane	1.0350	1.0558	1.0404
C10 Plus			
C10 Mole %	29.8220	46.8471	43.9999
Molecular Wt.	177.6260		
Specific Gravity	0.7548		
Total	100.00	100.00	100.00

QUESTAR ENERGY SERVICES

1210 D. Street, Rock Springs, Wyoming 82901
(307) 352-7292

Description:	US 8H	Company:	Petro Shale
Field:	Mckenzie	Data File:	002393.D
Meter Number:		G.C. Method:	GAS EXTENDED.M
Analysis Date/Time:	06-Mar-17, 10:30:28	GPA Method	GPA 2286
Date Sampled:	2-Mar-17	Sampled By:	WD
Sample Temperature:	89	Analyst Initials:	JFL
Sample Pressure:	32		

Component	Mol%	Wt%	LV%
Methane	56.5905	34.3070	44.5929
Ethane	21.8904	24.8738	27.2899
Propane	11.5154	19.1886	14.7601
Isobutane	1.2456	2.7359	1.8955
n-Butane	3.6969	8.1197	5.4216
Neopentane	0.0113	0.0308	0.0201
Isopentane	0.6312	1.7210	1.0747
n-Pentane	0.9382	2.5579	1.5806
2,2-Dimethylbutane	0.0047	0.0153	0.0091
2,3-Dimethylbutane	0.0461	0.1503	0.0879
2-Methylpentane	0.1564	0.5092	0.3018
3-Methylpentane	0.0941	0.3064	0.1786
n-Hexane	0.2267	0.7383	0.4336
Heptanes	0.4024	1.4357	0.7554
Octanes	0.0444	0.1897	0.1017
Nonanes	0.0213	0.0863	0.0387
Decanes plus	0.0052	0.0282	0.0150
Nitrogen	1.8481	1.9563	0.9425
Carbon Dioxide	0.6311	1.0496	0.5003
Oxygen	ND	ND	ND
Hydrogen Sulfide	ND	ND	ND
Total	100.0000	100.0000	100.0000

Calculated Global Properties		**Units**
Gross BTU/Real CF	1535.4	BTU/SCF at 60°F and14.73 psia
Sat.Gross BTU/Real CF	1510.2	BTU/SCF at 60°F and14.73 psia
Gas Compressibility (Z)	0.9941	
Specific Gravity	0.9160	air=1
Avg Molecular Weight	26.463	gm/mole
Propane GPM	3.155942	gal/MCF
Butane GPM	1.569078	gal/MCF
Gasoline GPM	0.947957	gal/MCF
26# Gasoline GPM	2.114046	gal/MCF
Total GPM	11.858136	gal/MCF
Base Mol%	99.052	%v/v

H2S detection limit 100 ppm (+/-)

Component	Mol%	Wt%	LV%
Benzene	0.0235	0.0693	0.0306
Toluene	0.0248	0.0864	0.0386
Ethylbenzene	0.0086	0.0346	0.0155
M&P Xylene	0.0038	0.0153	0.0069
O-Xylene	0.0082	0.0330	0.0145
2,2,4-Trimethylpentane	0.0215	0.0929	0.0503
Cyclopentane	0.0000	0.0000	0.0000
Cyclohexane	0.0384	0.1220	0.0607
Methylcyclohexane	0.0440	0.1632	0.0822
Description:	US 8H		

GRI GlyCalc Information

Component	Mol%	Wt%	LV%
Carbon Dioxide	0.6311	1.0496	0.5003
Hydrogen Sulfide	ND	ND	ND
Nitrogen	1.8481	1.9563	0.9425
Methane	56.5905	34.3070	44.5929
Ethane	21.8904	24.8738	27.2899
Propane	11.5154	19.1886	14.7601
Isobutane	1.2456	2.7359	1.8955
n-Butane	3.7082	8.1197	5.4216
Isopentane	0.6312	1.7518	1.0948
n-Pentane	0.9382	2.5579	1.5806
Cyclopentane	0.0000	0.0000	0.0000
n-Hexane	0.2267	0.7383	0.4336
Cyclohexane	0.0384	0.1220	0.0607
Other Hexanes	0.3013	0.9812	0.5774
Heptanes	0.2502	0.9019	0.4930
Methylcyclohexane	0.0440	0.1632	0.0822
2,2,4 Trimethylpentane	0.0215	0.0929	0.0503
Benzene	0.0235	0.0693	0.0306
Toluene	0.0248	0.0864	0.0386
Ethylbenzene	0.0086	0.0346	0.0155
Xylenes	0.0120	0.0483	0.0214
C8+ Heavies	0.0503	0.2213	0.1185
Subtotal	100.0000	100.0000	100.0000
Oxygen	ND	ND	ND
Total	100.0000	100.0000	100.0000

Petroshale (US), Inc.
PETROSHALE US 8H
Natural Gas Analysis Summary

Tank Vapor Compositional Analysis

Species	Formula	MW	Mole %	Mole Fraction	Weight %
Hydrogen sulfide	H_2S	34.08	0.0000	0.0000	0.000
Oxygen	O_2	32.00	0.0000	0.0000	0.000
Nitrogen	N_2	28.01	1.8481	0.0185	1.958
Carbon dioxide	CO_2	44.01	0.6311	0.0063	1.050
Methane	C1	16.04	56.5905	0.5659	34.335
Ethane	C2	30.07	21.8904	0.2189	24.894
Propane	C3	44.10	11.5154	0.1152	19.204
iso-Butane	iC4	58.12	1.2456	0.0125	2.738
n-Butane	nC4	58.12	3.7477	0.0375	8.238
iso-Pentane	iC5	72.15	0.6425	0.0064	1.753
n-Pentane	nC5	72.15	1.1887	0.0119	3.244
Cyclopentane	C_5H_{10}	70.13	0.0000	0.0000	0.000
C6 Mix	C6	86.18	0.0000	0.0000	0.000
n-Hexane	C_6H_{14}	86.18	0.2267	0.0023	0.739
Cyclohexane	C_6H_{12}	84.16	0.0000	0.0000	0.000
Hexanes	C6	86.18	0.0000	0.0000	0.000
Benzene	C_6H_6	78.11	0.0000	0.0000	0.000
Heptanes	C7	100.20	0.4024	0.0040	1.525
Methylcyclohexane	C_7H_{14}	98.19	0.0000	0.0000	0.000
Toluene	C_7H_8	92.14	0.0000	0.0000	0.000
Octanes	C8	114.23	0.0444	0.0004	0.192
Ethylbenzene	C_8H_{10}	106.17	0.0000	0.0000	0.000
Xylenes	C_8H_{10}	106.17	0.0000	0.0000	0.000
2,2,4-Trimethylpentane	C_8H_{18}	114.23	0.0000	0.0000	0.000
Nonanes	C9	128.26	0.0213	0.0002	0.103
Pseudo Comp1	-	102.91	0.0000	0.0000	0.000
Pseudo Comp2	-	121.00	0.0000	0.0000	0.000
Pseudo Comp3	-	134.00	0.0000	0.0000	0.000
Pseudo Comp4	-	152.95	0.0000	0.0000	0.000
Pseudo Comp5	-	217.22	0.0000	0.0000	0.000
Decanes+	C10+	142.29	0.0052	0.0001	0.028
Total:			**100.000**	**1.000**	**100.000**

Tank Vapor Analysis Summary

$$CC_{Mixture} = \frac{\sum_{i=1}^{\#\ of\ Components}(n \times AW_{Carbon} \times Xmi)}{\sum_{i=1}^{\#\ of\ Components}(MWi \times Xmi)}$$

Parameter	Mole %	Mole Fraction	Weight %
Total Methane (CH_4)	56.59	0.566	34.33
Total Carbon Dioxide (CO_2)	0.63	0.006	1.05
Total Hazardous Air Pollutants (HAPs)	0.23	0.002	0.74
Total Volatile Organic Compounds (VOCs)	19.04	0.190	37.76
Total Hydrogen Sulfide (H_2S)	0.00	0.00	0.00

Petroshale (US), Inc.
PETROSHALE US 8H
E&P TANK Tank Vapor Analysis

Tank Vapor Compositional Analysis

Species	Formula	MW	Mole %	Mole Fraction	Weight %
Hydrogen sulfide	H_2S	34.08	0.0000	0.0000	0.000
Oxygen	O_2	32.00	0.0000	0.0000	0.000
Nitrogen	N_2	28.01	0.6277	0.0063	0.391
Carbon dioxide	CO_2	44.01	0.1491	0.0015	0.146
Methane	C1	16.04	2.0167	0.0202	0.720
Ethane	C2	30.07	22.2371	0.2224	14.872
Propane	C3	44.10	49.7363	0.4974	48.779
iso-Butane	iC4	58.12	5.1150	0.0512	6.612
n-Butane	nC4	58.12	14.3036	0.1430	18.490
iso-Pentane	iC5	72.15	1.7519	0.0175	2.811
n-Pentane	nC5	72.15	2.5393	0.0254	4.075
Cyclopentane	C_5H_{10}	70.13	0.0000	0.0000	0.000
C6 Mix	C6	86.18	0.0000	0.0000	0.000
n-Hexane	C_6H_{14}	86.18	0.4922	0.0049	0.943
Cyclohexane	C_6H_{12}	84.16	0.0000	0.0000	0.000
Hexanes	C6	86.18	0.4879	0.0049	0.935
Benzene	C_6H_6	78.11	0.0606	0.0006	0.105
Heptanes	C7	100.20	0.0000	0.0000	0.000
Methylcyclohexane	C_7H_{14}	98.19	0.0000	0.0000	0.000
Toluene	C_7H_8	92.14	0.0261	0.0003	0.053
Octanes	C8	114.23	0.0000	0.0000	0.000
Ethylbenzene	C_8H_{10}	106.17	0.0030	0.0000	0.007
Xylenes	C_8H_{10}	106.17	0.0117	0.0001	0.028
2,2,4-Trimethylpentane	C_8H_{18}	114.23	0.0359	0.0004	0.091
Nonanes	C9	128.26	0.0000	0.0000	0.000
Pseudo Comp1	-	102.91	0.3782	0.0038	0.866
Pseudo Comp2	-	121.00	0.0248	0.0002	0.067
Pseudo Comp3	-	134.00	0.0028	0.0000	0.008
Pseudo Comp4	-	152.95	0.0002	0.0000	0.001
Pseudo Comp5	-	217.22	0.0000	0.0000	0.000
Decanes+	C10+	142.29	0.0000	0.0000	0.000
Total:			**100.000**	**1.000**	**100.000**

Note: Tank vapor compositional analysis from E&P TANK modeling run.

Tank Vapor Analysis Summary

$$CC_{Mixture} = \frac{\sum_{i=1}^{\#\ of\ Components}(n \times AW_{Carbon} \times Xmi)}{\sum_{i=1}^{\#\ of\ Components}(MWi \times Xmi)}$$

Parameter	Mole %	Mole Fraction	Weight %
Total Methane (CH_4)	2.02	0.020	0.72
Total Carbon Dioxide (CO_2)	0.15	0.001	0.15
Total Hazardous Air Pollutants (HAPs)	0.63	0.006	1.23
Total Volatile Organic Compounds (VOCs)	74.97	0.750	83.87
Total Hydrogen Sulfide (H_2S)	0.00	0.00	0.00

```
****************************************************************************************
*     Project Setup Information                                                        *
****************************************************************************************
Project File              : C:\Documents and Settings\AirQuality\Desktop\Entire Primus Facility PTE version 2.0
Flowsheet Selection       : Oil Tank with Separator
Calculation Method        : RVP Distillation
Control Efficiency        : 98.0%
Known Separator Stream    : Low Pressure Oil
Entering Air Composition  : No

Filed Name                : Antelope
Well Name                 : Primus Facility
Well ID                   : PetroShale US8H, 12H, & 13H
Permit Number             : Entire Primus Facility PTE
Date                      : 2019.10.23


****************************************************************************************
*     Data Input                                                                       *
****************************************************************************************

Separator Pressure        : 32.00[psig]
Separator Temperature     : 89.00[F]
Ambient Pressure          : 14.70[psia]
Ambient Temperature       : 43.40[F]
C10+ SG                   : 0.7548
C10+ MW                   : 177.626

-- Low Pressure Oil ---------------------------------------------------------------------
   No.    Component             mol %
   1      H2S                   0.0000
   2      O2                    0.0000
   3      CO2                   0.0163
   4      N2                    0.0686
   5      C1                    0.2204
   6      C2                    2.4328
   7      C3                    6.2209
   8      i-C4                  1.6599
   9      n-C4                  7.7683
   10     i-C5                  3.0908
   11     n-C5                  6.2263
   12     C6                    4.3237
   13     C7                   14.6079
   14     C8                    7.5449
   15     C9                    6.7161
   16     C10+                 29.8224
   17     Benzene               0.5895
   18     Toluene               0.9843
   19     E-Benzene             0.3646
   20     Xylenes               1.7460
   21     n-C6                  4.5613
   22     224Trimethylp         1.0350

-- Sales Oil ----------------------------------------------------------------------------
Production Rate           : 2053.5[bbl/day]
Days of Annual Operation  : 365 [days/year]
API Gravity               : 67.9
Reid Vapor Pressure       : 7.60[psia]


****************************************************************************************
*     Calculation Results                                                              *
****************************************************************************************

-- Emission Summary ---------------------------------------------------------------------
Item                Uncontrolled   Uncontrolled   Controlled    Controlled
```

	[ton/yr]	[lb/hr]	[ton/yr]	[lb/hr]
Total HAPs	54.820	12.516	1.096	0.250
Total HC	4765.999	1088.128	95.320	21.763
VOCs, C2+	4736.507	1081.394	94.730	21.628
VOCs, C3+	4126.635	942.154	82.533	18.843

Uncontrolled Recovery Info.

Vapor	214.4400	[MSCFD]
HC Vapor	212.9700	[MSCFD]
GOR	104.43	[SCF/bbl]

-- Emission Composition ---

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	5.983	1.366	5.983	1.366
4	N2	16.028	3.659	16.028	3.659
5	C1	29.491	6.733	0.590	0.135
6	C2	609.873	139.240	12.197	2.785
7	C3	2154.595	491.917	43.092	9.838
8	i-C4	368.817	84.205	7.376	1.684
9	n-C4	1055.908	241.075	21.118	4.821
10	i-C5	150.882	34.448	3.018	0.689
11	n-C5	215.335	49.163	4.307	0.983
12	C6	50.780	11.594	1.016	0.232
13	C7	60.846	13.892	1.217	0.278
14	C8	10.500	2.397	0.210	0.048
15	C9	3.516	0.803	0.070	0.016
16	C10+	0.633	0.145	0.013	0.003
17	Benzene	4.827	1.102	0.097	0.022
18	Toluene	2.451	0.560	0.049	0.011
19	E-Benzene	0.321	0.073	0.006	0.001
20	Xylenes	1.321	0.302	0.026	0.006
21	n-C6	41.941	9.576	0.839	0.192
22	224Trimethylp	3.959	0.904	0.079	0.018
	Total	4788.007	1093.152	95.760	21.863

-- Stream Data ---

No.	Component	MW	LP Oil mol %	Flash Oil mol %	Sale Oil mol %	Flash Gas mol %	W&S Gas mol %	Total Emissions mol %
1	H2S	34.80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	O2	32.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	CO2	44.01	0.0163	0.0074	0.0000	0.3604	0.0731	0.1317
4	N2	28.01	0.0686	0.0045	0.0000	2.5417	0.0449	0.5541
5	C1	16.04	0.2204	0.0451	0.0000	6.9884	0.4459	1.7802
6	C2	30.07	2.4328	1.5442	0.0012	36.7372	15.2616	19.6415
7	C3	44.10	6.2209	5.5176	0.4140	33.3698	50.8914	47.3179
8	i-C4	58.12	1.6599	1.6133	1.0262	3.4599	6.8329	6.1450
9	n-C4	58.12	7.7683	7.6800	6.3801	11.1789	19.2362	17.5930
10	i-C5	72.15	3.0908	3.1298	3.2414	1.5855	2.1378	2.0252
11	n-C5	72.15	6.2263	6.3282	6.6977	2.2911	3.0438	2.8903
12	C6	86.16	4.3237	4.4237	4.8519	0.4624	0.6170	0.5854
13	C7	100.20	14.6079	14.9742	16.5861	0.4650	0.6440	0.6075
14	C8	114.23	7.5449	7.7386	8.5980	0.0673	0.0978	0.0916
15	C9	128.28	6.7161	6.8896	7.6612	0.0185	0.0300	0.0277
16	C10+	177.63	29.8224	30.5948	34.0357	0.0021	0.0038	0.0034
17	Benzene	78.11	0.5895	0.6036	0.6643	0.0470	0.0631	0.0598
18	Toluene	92.13	0.9843	1.0093	1.1197	0.0195	0.0274	0.0258
19	E-Benzene	106.17	0.3646	0.3740	0.4157	0.0021	0.0031	0.0029
20	Xylenes	106.17	1.7460	1.7910	1.9910	0.0087	0.0129	0.0120
21	n-C6	86.18	4.5613	4.6699	5.1392	0.3689	0.4976	0.4713
22	224Trimethylp	114.24	1.0350	1.0611	1.1765	0.0257	0.0356	0.0336
	MW		111.98	113.84	121.25	40.41	47.89	46.37
	Stream Mole Ratio		1.0000	0.9748	0.8762	0.0252	0.0986	0.1238
	Heating Value	[BTU/SCF]				2268.06	2715.46	2624.21
	Gas Gravity	[Gas/Air]				1.40	1.65	1.60

Bubble Pt. @ 100F	[psia]	47.50	29.98	8.22
RVP @ 100F	[psia]	25.93	20.86	7.59
Spec. Gravity @ 100F		0.668	0.670	0.677

```
******************************************************************************************
*     Project Setup Information                                                          *
******************************************************************************************
Project File              : C:\Documents and Settings\AirQuality\Desktop\Entire Primus Facility Actual Emissions
Flowsheet Selection       : Oil Tank with Separator
Calculation Method        : RVP Distillation
Control Efficiency        : 98.0%
Known Separator Stream    : Low Pressure Oil
Entering Air Composition  : No

Filed Name                : Antelope
Well Name                 : Primus Facility
Well ID                   : PetroShale US8H, 12H, & 13H
Permit Number             : Entire Primus Facility Actual Emissions
Date                      : 2019.10.23


******************************************************************************************
*     Data Input                                                                         *
******************************************************************************************

Separator Pressure        : 32.00[psig]
Separator Temperature     : 89.00[F]
Ambient Pressure          : 14.70[psia]
Ambient Temperature       : 43.40[F]
C10+ SG                   : 0.7548
C10+ MW                   : 177.626

-- Low Pressure Oil ----------------------------------------------------------------------
   No.    Component            mol %
   1      H2S                  0.0000
   2      O2                   0.0000
   3      CO2                  0.0163
   4      N2                   0.0686
   5      C1                   0.2204
   6      C2                   2.4328
   7      C3                   6.2209
   8      i-C4                 1.6599
   9      n-C4                 7.7683
   10     i-C5                 3.0908
   11     n-C5                 6.2263
   12     C6                   4.3237
   13     C7                  14.6079
   14     C8                   7.5449
   15     C9                   6.7161
   16     C10+                29.8224
   17     Benzene              0.5895
   18     Toluene              0.9843
   19     E-Benzene            0.3646
   20     Xylenes              1.7460
   21     n-C6                 4.5613
   22     224Trimethylp        1.0350

-- Sales Oil -----------------------------------------------------------------------------
Production Rate           : 1327[bbl/day]
Days of Annual Operation  : 365 [days/year]
API Gravity               : 67.9
Reid Vapor Pressure       : 7.60[psia]


******************************************************************************************
*     Calculation Results                                                                *
******************************************************************************************

-- Emission Summary ----------------------------------------------------------------------
Item                Uncontrolled   Uncontrolled   Controlled     Controlled
```


ED_004016P_00013088-00080

	[ton/yr]	[lb/hr]	[ton/yr]	[lb/hr]
Total HAPs	35.420	8.087	0.708	0.162
Total HC	3079.622	703.110	61.592	14.062
VOCs, C2+	3060.566	698.759	61.211	13.975
VOCs, C3+	2666.487	608.787	53.330	12.176

Uncontrolled Recovery Info.

Vapor	138.5600	[MSCFD]
HC Vapor	137.6100	[MSCFD]
GOR	104.42	[SCF/bbl]

-- Emission Composition ---

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	3.866	0.883	3.866	0.883
4	N2	10.357	2.365	10.357	2.365
5	C1	19.056	4.351	0.381	0.087
6	C2	394.078	89.972	7.882	1.799
7	C3	1392.224	317.859	27.844	6.357
8	i-C4	238.317	54.410	4.766	1.088
9	n-C4	682.291	155.774	13.646	3.115
10	i-C5	97.495	22.259	1.950	0.445
11	n-C5	139.142	31.768	2.783	0.635
12	C6	32.812	7.491	0.656	0.150
13	C7	39.317	8.976	0.786	0.180
14	C8	6.785	1.549	0.136	0.031
15	C9	2.272	0.519	0.045	0.010
16	C10+	0.409	0.093	0.008	0.002
17	Benzene	3.119	0.712	0.062	0.014
18	Toluene	1.584	0.362	0.032	0.007
19	E-Benzene	0.208	0.047	0.004	0.001
20	Xylenes	0.853	0.195	0.017	0.004
21	n-C6	27.101	6.187	0.542	0.124
22	224Trimethylp	2.558	0.584	0.051	0.012
	Total	3093.844	706.357	61.877	14.127

-- Stream Data ---

No.	Component	MW	LP Oil mol %	Flash Oil mol %	Sale Oil mol %	Flash Gas mol %	W&S Gas mol %	Total Emissions mol %
1	H2S	34.80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	O2	32.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	CO2	44.01	0.0163	0.0074	0.0000	0.3604	0.0731	0.1317
4	N2	28.01	0.0686	0.0045	0.0000	2.5417	0.0449	0.5541
5	C1	16.04	0.2204	0.0451	0.0000	6.9884	0.4459	1.7802
6	C2	30.07	2.4328	1.5442	0.0012	36.7372	15.2616	19.6415
7	C3	44.10	6.2209	5.5176	0.4140	33.3698	50.8914	47.3179
8	i-C4	58.12	1.6599	1.6133	1.0262	3.4599	6.8329	6.1450
9	n-C4	58.12	7.7683	7.6800	6.3801	11.1789	19.2362	17.5930
10	i-C5	72.15	3.0908	3.1298	3.2414	1.5855	2.1378	2.0252
11	n-C5	72.15	6.2263	6.3282	6.6977	2.2911	3.0438	2.8903
12	C6	86.16	4.3237	4.4237	4.8519	0.4624	0.6170	0.5854
13	C7	100.20	14.6079	14.9742	16.5861	0.4650	0.6440	0.6075
14	C8	114.23	7.5449	7.7386	8.5980	0.0673	0.0978	0.0916
15	C9	128.28	6.7161	6.8896	7.6612	0.0185	0.0300	0.0277
16	C10+	177.63	29.8224	30.5948	34.0357	0.0021	0.0038	0.0034
17	Benzene	78.11	0.5895	0.6036	0.6643	0.0470	0.0631	0.0598
18	Toluene	92.13	0.9843	1.0093	1.1197	0.0195	0.0274	0.0258
19	E-Benzene	106.17	0.3646	0.3740	0.4157	0.0021	0.0031	0.0029
20	Xylenes	106.17	1.7460	1.7910	1.9910	0.0087	0.0129	0.0120
21	n-C6	86.18	4.5613	4.6699	5.1392	0.3689	0.4976	0.4713
22	224Trimethylp	114.24	1.0350	1.0611	1.1765	0.0257	0.0356	0.0336
	MW		111.98	113.84	121.25	40.41	47.89	46.37
	Stream Mole Ratio		1.0000	0.9748	0.8762	0.0252	0.0986	0.1238
	Heating Value	[BTU/SCF]				2268.06	2715.46	2624.21
	Gas Gravity	[Gas/Air]				1.40	1.65	1.60

Bubble Pt. @ 100F	[psia]	47.50	29.98	8.22
RVP @ 100F	[psia]	25.93	20.86	7.59
Spec. Gravity @ 100F		0.668	0.670	0.677

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification	
User Identification:	Produced Water Tank
City:	
State:	North Dakota
Company:	PetroShale (US), Inc.
Type of Tank:	Vertical Fixed Roof Tank
Description:	Produced Water Tank - PetroShale US8H
Tank Dimensions	
Shell Height (ft):	20.00
Diameter (ft):	12.00
Liquid Height (ft) :	17.50
Avg. Liquid Height (ft):	17.50
Volume (gallons):	16,074.56
Turnovers:	41.77
Net Throughput(gal/yr):	671,386.37
Is Tank Heated (y/n):	N
Paint Characteristics	
Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good
Roof Characteristics	
Type:	Cone
Height (ft)	1.00
Slope (ft/ft) (Cone Roof)	0.17
Breather Vent Settings	
Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Williston, North Dakota (Avg Atmospheric Pressure = 13.82 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Produced Water Tank - Vertical Fixed Roof Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Produced Water	Jan	27.65	23.33	31.96	41.45	0.0862	0.0730	0.1016	22.7094			18.88	
Crude oil (RVP 8)						2.7712	2.5381	3.0211	50.0000	0.0500	0.3229	207.00	Option 4: RVP=7.6
Water						0.0739	0.0617	0.0882	18.0200	0.9500	0.6771	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Feb	31.17	26.51	35.84	41.45	0.0986	0.0825	0.1175	22.4208			18.88	
Crude oil (RVP 8)						2.9742	2.7079	3.2609	50.0000	0.0500	0.3069	207.00	Option 4: RVP=7.6
Water						0.0854	0.0705	0.1031	18.0200	0.9500	0.6931	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Mar	37.19	31.92	42.46	41.45	0.1235	0.1014	0.1499	21.9740			18.88	
Crude oil (RVP 8)						3.3476	3.0183	3.7046	50.0000	0.0500	0.2813	207.00	Option 4: RVP=7.6
Water						0.1087	0.0880	0.1336	18.0200	0.9500	0.7187	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Apr	44.20	37.87	50.52	41.45	0.1596	0.1266	0.2001	21.5183			18.88	
Crude oil (RVP 8)						3.8282	3.3921	4.3076	50.0000	0.0500	0.2542	207.00	Option 4: RVP=7.6
Water						0.1428	0.1117	0.1813	18.0200	0.9500	0.7458	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	May	49.98	43.10	56.85	41.45	0.1963	0.1534	0.2497	21.1885			18.88	
Crude oil (RVP 8)						4.2645	3.7499	4.8331	50.0000	0.0500	0.2338	207.00	Option 4: RVP=7.6
Water						0.1777	0.1369	0.2287	18.0200	0.9500	0.7662	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jun	54.43	47.20	61.65	41.45	0.2296	0.1779	0.2944	20.9594			18.88	
Crude oil (RVP 8)						4.6266	4.0507	5.2649	50.0000	0.0500	0.2193	207.00	Option 4: RVP=7.6
Water						0.2094	0.1601	0.2716	18.0200	0.9500	0.7807	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jul	57.24	49.54	64.95	41.45	0.2531	0.1933	0.3290	20.8248			18.88	
Crude oil (RVP 8)						4.8675	4.2302	5.5778	50.0000	0.0500	0.2106	207.00	Option 4: RVP=7.6
Water						0.2320	0.1748	0.3049	18.0200	0.9500	0.7894	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Aug	55.94	48.47	63.41	41.45	0.2420	0.1861	0.3124	20.8862			18.88	
Crude oil (RVP 8)						4.7548	4.1471	5.4303	50.0000	0.0500	0.2146	207.00	Option 4: RVP=7.6
Water						0.2213	0.1679	0.2890	18.0200	0.9500	0.7854	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Sep	49.76	43.18	56.34	41.45	0.1948	0.1538	0.2454	21.2000			18.88	
Crude oil (RVP 8)						4.2476	3.7554	4.7893	50.0000	0.0500	0.2345	207.00	Option 4: RVP=7.6
Water						0.1763	0.1373	0.2245	18.0200	0.9500	0.7655	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Oct	44.08	38.23	49.93	41.45	0.1589	0.1283	0.1960	21.5254			18.88	
Crude oil (RVP 8)						3.8198	3.4157	4.2608	50.0000	0.0500	0.2546	207.00	Option 4: RVP=7.6
Water						0.1422	0.1133	0.1774	18.0200	0.9500	0.7454	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Nov	35.80	31.32	40.28	41.45	0.1173	0.0991	0.1384	22.0723			18.88	
Crude oil (RVP 8)						3.2582	2.9831	3.5531	50.0000	0.0500	0.2870	207.00	Option 4: RVP=7.6
Water						0.1029	0.0859	0.1227	18.0200	0.9500	0.7130	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Dec	29.47	25.33	33.61	41.45	0.0924	0.0788	0.1080	22.5579			18.88	
Crude oil (RVP 8)						2.8745	2.6437	3.1211	50.0000	0.0500	0.3145	207.00	Option 4: RVP=7.6
Water						0.0796	0.0671	0.0942	18.0200	0.9500	0.6855	18.02	Option 2: A=8.10765, B=1750.286, C=235

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Produced Water Tank - Vertical Fixed Roof Tank

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	0.1216	0.1344	0.2066	0.3053	0.4154	0.4893	0.5929	0.5503	0.3809	0.2887	0.1592	0.1230
Vapor Space Volume (cu ft):	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Vented Vapor Saturation Factor:	0.9872	0.9854	0.9818	0.9766	0.9714	0.9667	0.9634	0.9649	0.9716	0.9767	0.9827	0.9863
Tank Vapor Space Volume:												
Vapor Space Volume (cu ft):	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425
Tank Diameter (ft):	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000
Vapor Space Outage (ft):	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333
Tank Shell Height (ft):	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000
Average Liquid Height (ft):	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Height (ft):	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Roof Slope (ft/ft):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Shell Radius (ft):	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000
Vapor Density												
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Daily Avg. Liquid Surface Temp. (deg. R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Average Ambient Temp. (deg. F):	8.9000	16.0500	28.4000	43.1500	55.2500	64.7000	70.6500	68.7000	56.2500	44.7500	27.1500	13.2000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	388.0000	671.0000	1,104.0000	1,488.0000	1,827.0000	2,047.0000	2,193.0000	1,862.0000	1,340.0000	877.0000	479.0000	334.0000
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Daily Vapor Temperature Range (deg. R):	17.2549	18.6740	21.0950	25.2989	27.4885	28.8957	30.8147	29.8871	26.3224	23.3985	17.9040	16.5658
Daily Vapor Pressure Range (psia):	0.0286	0.0350	0.0485	0.0735	0.0963	0.1165	0.1357	0.1264	0.0915	0.0677	0.0392	0.0292
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0730	0.0825	0.1014	0.1266	0.1534	0.1779	0.1933	0.1861	0.1538	0.1283	0.0991	0.0788
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.1016	0.1175	0.1499	0.2001	0.2497	0.2944	0.3290	0.3124	0.2454	0.1960	0.1384	0.1080
Daily Avg. Liquid Surface Temp. (deg R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Min. Liquid Surface Temp. (deg R):	483.0049	486.1762	491.5864	497.5412	502.7731	506.8747	509.2091	508.1384	502.8506	497.8997	490.9948	484.9966
Daily Max. Liquid Surface Temp. (deg R):	491.6323	495.5132	502.1340	510.1906	516.5173	521.3226	524.6164	523.0820	516.0118	509.5990	499.9468	493.2796
Daily Ambient Temp. Range (deg. R):	21.4000	21.5000	22.0000	25.3000	26.1000	26.6000	28.3000	29.2000	27.7000	26.7000	21.7000	20.8000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.9872	0.9854	0.9818	0.9766	0.9714	0.9667	0.9634	0.9649	0.9716	0.9767	0.9827	0.9863
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Space Outage (ft):	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333
Working Losses (lb):	1.7306	1.9540	2.3991	3.0366	3.6775	4.2542	4.6604	4.4682	3.6517	3.0248	2.2885	1.8427

Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Net Throughput (gal/mo.):	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642	55,948.8642
Annual Turnovers:	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670	41.7670
Turnover Factor:	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849	0.8849
Maximum Liquid Volume (gal):	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628
Maximum Liquid Height (ft):	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000
Tank Diameter (ft):	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000
Working Loss Product Factor:	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
Total Losses (lb):	1.8522	2.0884	2.6056	3.3419	4.0929	4.7435	5.2533	5.0184	4.0326	3.3135	2.4478	1.9657

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January, February, March, April, May, June, July, August, September, October, November, December

Produced Water Tank - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	36.99	3.77	40.76
Crude oil (RVP 8)	9.20	0.91	10.11
Water	27.79	2.86	30.64

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Produced Water Tank
City:	
State:	North Dakota
Company:	PetroShale (US), Inc.
Type of Tank:	Vertical Fixed Roof Tank
Description:	Produced Water Tank - PetroShale US12H & US 13H

Tank Dimensions

Shell Height (ft):	30.00
Diameter (ft):	15.50
Liquid Height (ft) :	28.50
Avg. Liquid Height (ft):	28.50
Volume (gallons):	40,228.27
Turnovers:	56.47
Net Throughput(gal/yr):	2,271,670.82
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	1.00
Slope (ft/ft) (Cone Roof)	0.13

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Williston, North Dakota (Avg Atmospheric Pressure = 13.82 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Produced Water Tank - Vertical Fixed Roof Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Produced Water	Jan	27.65	23.33	31.96	41.45	0.0862	0.0730	0.1016	22.7094			18.88	
Crude oil (RVP 8)						2.7712	2.5381	3.0211	50.0000	0.0500	0.3229	207.00	Option 4: RVP=7.6
Water						0.0739	0.0617	0.0882	18.0200	0.9500	0.6771	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Feb	31.17	26.51	35.84	41.45	0.0986	0.0825	0.1175	22.4208			18.88	
Crude oil (RVP 8)						2.9742	2.7079	3.2609	50.0000	0.0500	0.3069	207.00	Option 4: RVP=7.6
Water						0.0854	0.0705	0.1031	18.0200	0.9500	0.6931	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Mar	37.19	31.92	42.46	41.45	0.1235	0.1014	0.1499	21.9740			18.88	
Crude oil (RVP 8)						3.3476	3.0183	3.7046	50.0000	0.0500	0.2813	207.00	Option 4: RVP=7.6
Water						0.1087	0.0880	0.1336	18.0200	0.9500	0.7187	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Apr	44.20	37.87	50.52	41.45	0.1596	0.1266	0.2001	21.5183			18.88	
Crude oil (RVP 8)						3.8282	3.3921	4.3076	50.0000	0.0500	0.2542	207.00	Option 4: RVP=7.6
Water						0.1428	0.1117	0.1813	18.0200	0.9500	0.7458	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	May	49.98	43.10	56.85	41.45	0.1963	0.1534	0.2497	21.1885			18.88	
Crude oil (RVP 8)						4.2645	3.7499	4.8331	50.0000	0.0500	0.2338	207.00	Option 4: RVP=7.6
Water						0.1777	0.1369	0.2287	18.0200	0.9500	0.7662	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jun	54.43	47.20	61.65	41.45	0.2296	0.1779	0.2944	20.9594			18.88	
Crude oil (RVP 8)						4.6266	4.0507	5.2649	50.0000	0.0500	0.2193	207.00	Option 4: RVP=7.6
Water						0.2094	0.1601	0.2716	18.0200	0.9500	0.7807	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jul	57.24	49.54	64.95	41.45	0.2531	0.1933	0.3290	20.8248			18.88	
Crude oil (RVP 8)						4.8675	4.2302	5.5778	50.0000	0.0500	0.2106	207.00	Option 4: RVP=7.6
Water						0.2320	0.1748	0.3049	18.0200	0.9500	0.7894	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Aug	55.94	48.47	63.41	41.45	0.2420	0.1861	0.3124	20.8862			18.88	
Crude oil (RVP 8)						4.7548	4.1471	5.4303	50.0000	0.0500	0.2146	207.00	Option 4: RVP=7.6
Water						0.2213	0.1679	0.2890	18.0200	0.9500	0.7854	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Sep	49.76	43.18	56.34	41.45	0.1948	0.1538	0.2454	21.2000			18.88	
Crude oil (RVP 8)						4.2476	3.7554	4.7893	50.0000	0.0500	0.2345	207.00	Option 4: RVP=7.6
Water						0.1763	0.1373	0.2245	18.0200	0.9500	0.7655	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Oct	44.08	38.23	49.93	41.45	0.1589	0.1283	0.1960	21.5254			18.88	
Crude oil (RVP 8)						3.8198	3.4157	4.2608	50.0000	0.0500	0.2546	207.00	Option 4: RVP=7.6
Water						0.1422	0.1133	0.1774	18.0200	0.9500	0.7454	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Nov	35.80	31.32	40.28	41.45	0.1173	0.0991	0.1384	22.0723			18.88	
Crude oil (RVP 8)						3.2582	2.9831	3.5531	50.0000	0.0500	0.2870	207.00	Option 4: RVP=7.6
Water						0.1029	0.0859	0.1227	18.0200	0.9500	0.7130	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Dec	29.47	25.33	33.61	41.45	0.0924	0.0788	0.1080	22.5579			18.88	
Crude oil (RVP 8)						2.8745	2.6437	3.1211	50.0000	0.0500	0.3145	207.00	Option 4: RVP=7.6
Water						0.0796	0.0671	0.0942	18.0200	0.9500	0.6855	18.02	Option 2: A=8.10765, B=1750.286, C=235

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Produced Water Tank - Vertical Fixed Roof Tank

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	0.1318	0.1458	0.2244	0.3324	0.4530	0.5345	0.6484	0.6015	0.4154	0.3142	0.1729	0.1335
Vapor Space Volume (cu ft):	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Vented Vapor Saturation Factor:	0.9917	0.9905	0.9881	0.9847	0.9813	0.9782	0.9760	0.9770	0.9814	0.9848	0.9887	0.9911
Tank Vapor Space Volume:												
Vapor Space Volume (cu ft):	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352
Tank Diameter (ft):	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000
Vapor Space Outage (ft):	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333
Tank Shell Height (ft):	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000
Average Liquid Height (ft):	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Height (ft):	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Roof Slope (ft/ft):	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Shell Radius (ft):	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500
Vapor Density												
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Daily Avg. Liquid Surface Temp. (deg. R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Average Ambient Temp. (deg. F):	8.9000	16.0500	28.4000	43.1500	55.2500	64.7000	70.6500	68.7000	56.2500	44.7500	27.1500	13.2000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	388.0000	671.0000	1,104.0000	1,488.0000	1,827.0000	2,047.0000	2,193.0000	1,862.0000	1,340.0000	877.0000	479.0000	334.0000
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Daily Vapor Temperature Range (deg. R):	17.2549	18.6740	21.0950	25.2989	27.4885	28.8957	30.8147	29.8871	26.3224	23.3985	17.9040	16.5658
Daily Vapor Pressure Range (psia):	0.0286	0.0350	0.0485	0.0735	0.0963	0.1165	0.1357	0.1264	0.0915	0.0677	0.0392	0.0292
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0730	0.0825	0.1014	0.1266	0.1534	0.1779	0.1933	0.1861	0.1538	0.1283	0.0991	0.0788
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.1016	0.1175	0.1499	0.2001	0.2497	0.2944	0.3290	0.3124	0.2454	0.1960	0.1384	0.1080
Daily Avg. Liquid Surface Temp. (deg R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Min. Liquid Surface Temp. (deg R):	483.0049	486.1762	491.5864	497.5412	502.7731	506.8747	509.2091	508.1384	502.8506	497.8997	490.9948	484.9966
Daily Max. Liquid Surface Temp. (deg R):	491.6323	495.5132	502.1340	510.1906	516.5173	521.3226	524.6164	523.0820	516.0118	509.5990	499.9468	493.2796
Daily Ambient Temp. Range (deg. R):	21.4000	21.5000	22.0000	25.3000	26.1000	26.6000	28.3000	29.2000	27.7000	26.7000	21.7000	20.8000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.9917	0.9905	0.9881	0.9847	0.9813	0.9782	0.9760	0.9770	0.9814	0.9848	0.9887	0.9911
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Space Outage (ft):	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333
Working Losses (lb):	4.6181	5.2143	6.4020	8.1032	9.8135	11.3525	12.4363	11.9234	9.7446	8.0717	6.1070	4.9172

Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Net Throughput (gal/mo.):	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020	189,305.9020
Annual Turnovers:	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695	56.4695
Turnover Factor:	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979	0.6979
Maximum Liquid Volume (gal):	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679
Maximum Liquid Height (ft):	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000
Tank Diameter (ft):	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000
Working Loss Product Factor:	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
Total Losses (lb):	4.7500	5.3601	6.6264	8.4355	10.2665	11.8870	13.0847	12.5249	10.1600	8.3859	6.2800	5.0507

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January, February, March, April, May, June, July, August, September, October, November, December

Produced Water Tank - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	98.70	4.11	102.81
Crude oil (RVP 8)	24.55	0.99	25.55
Water	74.15	3.12	77.27

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Produced Water Tank
City:	
State:	North Dakota
Company:	PetroShale (US), Inc.
Type of Tank:	Vertical Fixed Roof Tank
Description:	Produced Water Tank - PetroShale US8H

Tank Dimensions

Shell Height (ft):		20.00
Diameter (ft):		12.00
Liquid Height (ft) :		17.50
Avg. Liquid Height (ft):		17.50
Volume (gallons):		16,074.56
Turnovers:		30.01
Net Throughput(gal/yr):		482,338.50
Is Tank Heated (y/n):	N	

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone	
Height (ft)		1.00
Slope (ft/ft) (Cone Roof)		0.17

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Williston, North Dakota (Avg Atmospheric Pressure = 13.82 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Produced Water Tank - Vertical Fixed Roof Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Produced Water	Jan	27.65	23.33	31.96	41.45	0.0862	0.0730	0.1016	22.7094			18.88	
Crude oil (RVP 8)						2.7712	2.5381	3.0211	50.0000	0.0500	0.3229	207.00	Option 4: RVP=7.6
Water						0.0739	0.0617	0.0882	18.0200	0.9500	0.6771	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Feb	31.17	26.51	35.84	41.45	0.0986	0.0825	0.1175	22.4208			18.88	
Crude oil (RVP 8)						2.9742	2.7079	3.2609	50.0000	0.0500	0.3069	207.00	Option 4: RVP=7.6
Water						0.0854	0.0705	0.1031	18.0200	0.9500	0.6931	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Mar	37.19	31.92	42.46	41.45	0.1235	0.1014	0.1499	21.9740			18.88	
Crude oil (RVP 8)						3.3476	3.0183	3.7046	50.0000	0.0500	0.2813	207.00	Option 4: RVP=7.6
Water						0.1087	0.0880	0.1336	18.0200	0.9500	0.7187	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Apr	44.20	37.87	50.52	41.45	0.1596	0.1266	0.2001	21.5183			18.88	
Crude oil (RVP 8)						3.8282	3.3921	4.3076	50.0000	0.0500	0.2542	207.00	Option 4: RVP=7.6
Water						0.1428	0.1117	0.1813	18.0200	0.9500	0.7458	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	May	49.98	43.10	56.85	41.45	0.1963	0.1534	0.2497	21.1885			18.88	
Crude oil (RVP 8)						4.2645	3.7499	4.8331	50.0000	0.0500	0.2338	207.00	Option 4: RVP=7.6
Water						0.1777	0.1369	0.2287	18.0200	0.9500	0.7662	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jun	54.43	47.20	61.65	41.45	0.2296	0.1779	0.2944	20.9594			18.88	
Crude oil (RVP 8)						4.6266	4.0507	5.2649	50.0000	0.0500	0.2193	207.00	Option 4: RVP=7.6
Water						0.2094	0.1601	0.2716	18.0200	0.9500	0.7807	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jul	57.24	49.54	64.95	41.45	0.2531	0.1933	0.3290	20.8248			18.88	
Crude oil (RVP 8)						4.8675	4.2302	5.5778	50.0000	0.0500	0.2106	207.00	Option 4: RVP=7.6
Water						0.2320	0.1748	0.3049	18.0200	0.9500	0.7894	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Aug	55.94	48.47	63.41	41.45	0.2420	0.1861	0.3124	20.8862			18.88	
Crude oil (RVP 8)						4.7548	4.1471	5.4303	50.0000	0.0500	0.2146	207.00	Option 4: RVP=7.6
Water						0.2213	0.1679	0.2890	18.0200	0.9500	0.7854	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Sep	49.76	43.18	56.34	41.45	0.1948	0.1538	0.2454	21.2000			18.88	
Crude oil (RVP 8)						4.2476	3.7554	4.7893	50.0000	0.0500	0.2345	207.00	Option 4: RVP=7.6
Water						0.1763	0.1373	0.2245	18.0200	0.9500	0.7655	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Oct	44.08	38.23	49.93	41.45	0.1589	0.1283	0.1960	21.5254			18.88	
Crude oil (RVP 8)						3.8198	3.4157	4.2608	50.0000	0.0500	0.2546	207.00	Option 4: RVP=7.6
Water						0.1422	0.1133	0.1774	18.0200	0.9500	0.7454	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Nov	35.80	31.32	40.28	41.45	0.1173	0.0991	0.1384	22.0723			18.88	
Crude oil (RVP 8)						3.2582	2.9831	3.5531	50.0000	0.0500	0.2870	207.00	Option 4: RVP=7.6
Water						0.1029	0.0859	0.1227	18.0200	0.9500	0.7130	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Dec	29.47	25.33	33.61	41.45	0.0924	0.0788	0.1080	22.5579			18.88	
Crude oil (RVP 8)						2.8745	2.6437	3.1211	50.0000	0.0500	0.3145	207.00	Option 4: RVP=7.6
Water						0.0796	0.0671	0.0942	18.0200	0.9500	0.6855	18.02	Option 2: A=8.10765, B=1750.286, C=235

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Produced Water Tank - Vertical Fixed Roof Tank

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	0.1216	0.1344	0.2066	0.3053	0.4154	0.4893	0.5929	0.5503	0.3809	0.2887	0.1592	0.1230
Vapor Space Volume (cu ft):	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Vented Vapor Saturation Factor:	0.9872	0.9854	0.9818	0.9766	0.9714	0.9667	0.9634	0.9649	0.9716	0.9767	0.9827	0.9863
Tank Vapor Space Volume:												
Vapor Space Volume (cu ft):	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425	320.4425
Tank Diameter (ft):	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000
Vapor Space Outage (ft):	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333
Tank Shell Height (ft):	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000
Average Liquid Height (ft):	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Height (ft):	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Roof Slope (ft/ft):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Shell Radius (ft):	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000
Vapor Density												
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Daily Avg. Liquid Surface Temp. (deg. R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Average Ambient Temp. (deg. F):	8.9000	16.0500	28.4000	43.1500	55.2500	64.7000	70.6500	68.7000	56.2500	44.7500	27.1500	13.2000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	388.0000	671.0000	1,104.0000	1,488.0000	1,827.0000	2,047.0000	2,193.0000	1,862.0000	1,340.0000	877.0000	479.0000	334.0000
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Daily Vapor Temperature Range (deg. R):	17.2549	18.6740	21.0950	25.2989	27.4885	28.8957	30.8147	29.8871	26.3224	23.3985	17.9040	16.5658
Daily Vapor Pressure Range (psia):	0.0286	0.0350	0.0485	0.0735	0.0963	0.1165	0.1357	0.1264	0.0915	0.0677	0.0392	0.0292
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0730	0.0825	0.1014	0.1266	0.1534	0.1779	0.1933	0.1861	0.1538	0.1283	0.0991	0.0788
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.1016	0.1175	0.1499	0.2001	0.2497	0.2944	0.3290	0.3124	0.2454	0.1960	0.1384	0.1080
Daily Avg. Liquid Surface Temp. (deg R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Min. Liquid Surface Temp. (deg R):	483.0049	486.1762	491.5864	497.5412	502.7731	506.8747	509.2091	508.1384	502.8506	497.8997	490.9948	484.9966
Daily Max. Liquid Surface Temp. (deg R):	491.6323	495.5132	502.1340	510.1906	516.5173	521.3226	524.6164	523.0820	516.0118	509.5990	499.9468	493.2796
Daily Ambient Temp. Range (deg. R):	21.4000	21.5000	22.0000	25.3000	26.1000	26.6000	28.3000	29.2000	27.7000	26.7000	21.7000	20.8000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.9872	0.9854	0.9818	0.9766	0.9714	0.9667	0.9634	0.9649	0.9716	0.9767	0.9827	0.9863
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Space Outage (ft):	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333	2.8333
Working Losses (lb):	1.4050	1.5863	1.9477	2.4652	2.9855	3.4537	3.7835	3.6274	2.9646	2.4556	1.8579	1.4959

Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Net Throughput (gal/mo.):	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750	40,194.8750
Annual Turnovers:	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063	30.0063
Turnover Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Maximum Liquid Volume (gal):	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628	16,074.5628
Maximum Liquid Height (ft):	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000	17.5000
Tank Diameter (ft):	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000
Working Loss Product Factor:	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
Total Losses (lb):	1.5265	1.7207	2.1542	2.7705	3.4009	3.9430	4.3763	4.1777	3.3455	2.7443	2.0171	1.6190

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January, February, March, April, May, June, July, August, September, October, November, December

Produced Water Tank - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	30.03	3.77	33.80
Crude oil (RVP 8)	7.47	0.91	8.38
Water	22.56	2.86	25.42

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Produced Water Tank
City:	
State:	North Dakota
Company:	PetroShale (US), Inc.
Type of Tank:	Vertical Fixed Roof Tank
Description:	Produced Water Tank - PetroShale US12H & US 13H

Tank Dimensions

Shell Height (ft):		30.00
Diameter (ft):		15.50
Liquid Height (ft) :		28.50
Avg. Liquid Height (ft):		28.50
Volume (gallons):		40,228.27
Turnovers:		36.78
Net Throughput(gal/yr):		1,479,480.12
Is Tank Heated (y/n):	N	

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone	
Height (ft)		1.00
Slope (ft/ft) (Cone Roof)		0.13

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Williston, North Dakota (Avg Atmospheric Pressure = 13.82 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Produced Water Tank - Vertical Fixed Roof Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Produced Water	Jan	27.65	23.33	31.96	41.45	0.0862	0.0730	0.1016	22.7094			18.88	
Crude oil (RVP 8)						2.7712	2.5381	3.0211	50.0000	0.0500	0.3229	207.00	Option 4: RVP=7.6
Water						0.0739	0.0617	0.0882	18.0200	0.9500	0.6771	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Feb	31.17	26.51	35.84	41.45	0.0986	0.0825	0.1175	22.4208			18.88	
Crude oil (RVP 8)						2.9742	2.7079	3.2609	50.0000	0.0500	0.3069	207.00	Option 4: RVP=7.6
Water						0.0854	0.0705	0.1031	18.0200	0.9500	0.6931	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Mar	37.19	31.92	42.46	41.45	0.1235	0.1014	0.1499	21.9740			18.88	
Crude oil (RVP 8)						3.3476	3.0183	3.7046	50.0000	0.0500	0.2813	207.00	Option 4: RVP=7.6
Water						0.1087	0.0880	0.1336	18.0200	0.9500	0.7187	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Apr	44.20	37.87	50.52	41.45	0.1596	0.1266	0.2001	21.5183			18.88	
Crude oil (RVP 8)						3.8282	3.3921	4.3076	50.0000	0.0500	0.2542	207.00	Option 4: RVP=7.6
Water						0.1428	0.1117	0.1813	18.0200	0.9500	0.7458	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	May	49.98	43.10	56.85	41.45	0.1963	0.1534	0.2497	21.1885			18.88	
Crude oil (RVP 8)						4.2645	3.7499	4.8331	50.0000	0.0500	0.2338	207.00	Option 4: RVP=7.6
Water						0.1777	0.1369	0.2287	18.0200	0.9500	0.7662	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jun	54.43	47.20	61.65	41.45	0.2296	0.1779	0.2944	20.9594			18.88	
Crude oil (RVP 8)						4.6266	4.0507	5.2649	50.0000	0.0500	0.2193	207.00	Option 4: RVP=7.6
Water						0.2094	0.1601	0.2716	18.0200	0.9500	0.7807	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Jul	57.24	49.54	64.95	41.45	0.2531	0.1933	0.3290	20.8248			18.88	
Crude oil (RVP 8)						4.8675	4.2302	5.5778	50.0000	0.0500	0.2106	207.00	Option 4: RVP=7.6
Water						0.2320	0.1748	0.3049	18.0200	0.9500	0.7894	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Aug	55.94	48.47	63.41	41.45	0.2420	0.1861	0.3124	20.8862			18.88	
Crude oil (RVP 8)						4.7548	4.1471	5.4303	50.0000	0.0500	0.2146	207.00	Option 4: RVP=7.6
Water						0.2213	0.1679	0.2890	18.0200	0.9500	0.7854	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Sep	49.76	43.18	56.34	41.45	0.1948	0.1538	0.2454	21.2000			18.88	
Crude oil (RVP 8)						4.2476	3.7554	4.7893	50.0000	0.0500	0.2345	207.00	Option 4: RVP=7.6
Water						0.1763	0.1373	0.2245	18.0200	0.9500	0.7655	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Oct	44.08	38.23	49.93	41.45	0.1589	0.1283	0.1960	21.5254			18.88	
Crude oil (RVP 8)						3.8198	3.4157	4.2608	50.0000	0.0500	0.2546	207.00	Option 4: RVP=7.6
Water						0.1422	0.1133	0.1774	18.0200	0.9500	0.7454	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Nov	35.80	31.32	40.28	41.45	0.1173	0.0991	0.1384	22.0723			18.88	
Crude oil (RVP 8)						3.2582	2.9831	3.5531	50.0000	0.0500	0.2870	207.00	Option 4: RVP=7.6
Water						0.1029	0.0859	0.1227	18.0200	0.9500	0.7130	18.02	Option 2: A=8.10765, B=1750.286, C=235
Produced Water	Dec	29.47	25.33	33.61	41.45	0.0924	0.0788	0.1080	22.5579			18.88	
Crude oil (RVP 8)						2.8745	2.6437	3.1211	50.0000	0.0500	0.3145	207.00	Option 4: RVP=7.6
Water						0.0796	0.0671	0.0942	18.0200	0.9500	0.6855	18.02	Option 2: A=8.10765, B=1750.286, C=235

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Produced Water Tank - Vertical Fixed Roof Tank

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	0.1318	0.1458	0.2244	0.3324	0.4530	0.5345	0.6484	0.6015	0.4154	0.3142	0.1729	0.1335
Vapor Space Volume (cu ft):	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Vented Vapor Saturation Factor:	0.9917	0.9905	0.9881	0.9847	0.9813	0.9782	0.9760	0.9770	0.9814	0.9848	0.9887	0.9911
Tank Vapor Space Volume:												
Vapor Space Volume (cu ft):	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352	345.9352
Tank Diameter (ft):	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000
Vapor Space Outage (ft):	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333
Tank Shell Height (ft):	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000	30.0000
Average Liquid Height (ft):	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Roof Height (ft):	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Roof Slope (ft/ft):	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Shell Radius (ft):	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500	7.7500
Vapor Density												
Vapor Density (lb/cu ft):	0.0004	0.0004	0.0005	0.0006	0.0008	0.0009	0.0010	0.0009	0.0008	0.0006	0.0005	0.0004
Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Daily Avg. Liquid Surface Temp. (deg. R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Average Ambient Temp. (deg. F):	8.9000	16.0500	28.4000	43.1500	55.2500	64.7000	70.6500	68.7000	56.2500	44.7500	27.1500	13.2000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192	501.1192
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	388.0000	671.0000	1,104.0000	1,488.0000	1,827.0000	2,047.0000	2,193.0000	1,862.0000	1,340.0000	877.0000	479.0000	334.0000
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.0331	0.0362	0.0416	0.0512	0.0566	0.0604	0.0652	0.0629	0.0540	0.0470	0.0346	0.0316
Daily Vapor Temperature Range (deg. R):	17.2549	18.6740	21.0950	25.2989	27.4885	28.8957	30.8147	29.8871	26.3224	23.3985	17.9040	16.5658
Daily Vapor Pressure Range (psia):	0.0286	0.0350	0.0485	0.0735	0.0963	0.1165	0.1357	0.1264	0.0915	0.0677	0.0392	0.0292
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0730	0.0825	0.1014	0.1266	0.1534	0.1779	0.1933	0.1861	0.1538	0.1283	0.0991	0.0788
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.1016	0.1175	0.1499	0.2001	0.2497	0.2944	0.3290	0.3124	0.2454	0.1960	0.1384	0.1080
Daily Avg. Liquid Surface Temp. (deg R):	487.3186	490.8447	496.8602	503.8659	509.6452	514.0987	516.9127	515.6102	509.4312	503.7493	495.4708	489.1381
Daily Min. Liquid Surface Temp. (deg R):	483.0049	486.1762	491.5864	497.5412	502.7731	506.8747	509.2091	508.1384	502.8506	497.8997	490.9948	484.9966
Daily Max. Liquid Surface Temp. (deg R):	491.6323	495.5132	502.1340	510.1906	516.5173	521.3226	524.6164	523.0820	516.0118	509.5990	499.9468	493.2796
Daily Ambient Temp. Range (deg. R):	21.4000	21.5000	22.0000	25.3000	26.1000	26.6000	28.3000	29.2000	27.7000	26.7000	21.7000	20.8000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.9917	0.9905	0.9881	0.9847	0.9813	0.9782	0.9760	0.9770	0.9814	0.9848	0.9887	0.9911
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Vapor Space Outage (ft):	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333	1.8333
Working Losses (lb):	4.2336	4.7801	5.8689	7.4284	8.9962	10.4071	11.4007	10.9304	8.9331	7.3995	5.5985	4.5077

Vapor Molecular Weight (lb/lb-mole):	22.7094	22.4208	21.9740	21.5183	21.1885	20.9594	20.8248	20.8862	21.2000	21.5254	22.0723	22.5579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0862	0.0986	0.1235	0.1596	0.1963	0.2296	0.2531	0.2420	0.1948	0.1589	0.1173	0.0924
Net Throughput (gal/mo.):	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100	123,290.0100
Annual Turnovers:	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771	36.7771
Turnover Factor:	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824	0.9824
Maximum Liquid Volume (gal):	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679	40,228.2679
Maximum Liquid Height (ft):	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000	28.5000
Tank Diameter (ft):	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000	15.5000
Working Loss Product Factor:	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
Total Losses (lb):	4.3654	4.9259	6.0933	7.7607	9.4492	10.9416	12.0491	11.5319	9.3485	7.7137	5.7714	4.6412

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January, February, March, April, May, June, July, August, September, October, November, December

Produced Water Tank - Vertical Fixed Roof Tank

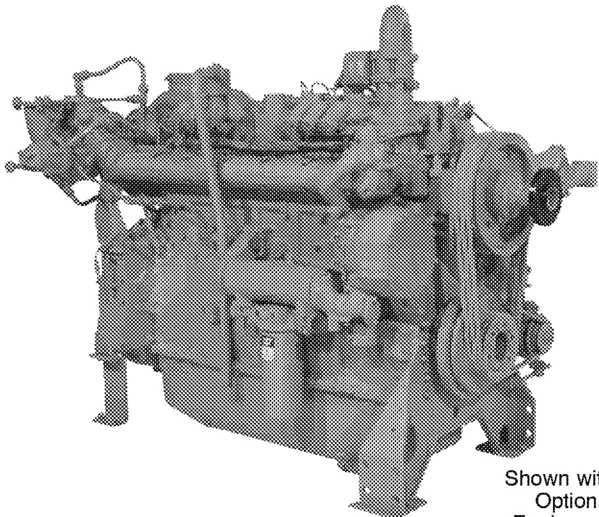
	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	90.48	4.11	94.59
Crude oil (RVP 8)	22.51	0.99	23.50
Water	67.98	3.12	71.09

CATERPILLAR®

G3406 Gas Petroleum Engine

160-272 bkW (215-365 bhp) 1800 rpm

0.5% O_2 and 2.0% O_2 Ratings



Shown with Optional Equipment

CAT® ENGINE SPECIFICATIONS

In-line 6, 4-Stroke-Cycle

Emissions Settings	0.5% O_2 and 2.0% O_2
Bore	137 mm (5.4 in.)
Stroke	165 mm (6.5 in.)
Displacement	18 L (1099 cu. in.)
Aspiration	Naturally Aspirated or Turbocharged-Aftercooled
Governor and Protection	Woodward PSG
Combustion	Rich Burn
Engine Weight, net dry (approx)	1360.8 kg (3000 lb)
Power Density	6.7 kg/kW (11 lb/bhp)
Power per Displacement	18.6 bhp/L
Total Cooling System Capacity	37.9 L (10 gal)
Jacket Water	30.3 L (8 gal)
SCAC	7.6 L (2 gal)
Lube Oil System (refill)	75.7 L (20 gal)
Oil Change Interval	750 hours
Rotation (from flywheel end)	Counterclockwise
Flywheel and Flywheel Housing	SAE No. 1
Flywheel Teeth	113

FEATURES

Engine Design
- Proven reliability and durability
- Ability to burn a wide spectrum of gaseous fuels
- Robust diesel strength design prolongs life and lowers owning and operating costs
- Broad operating speed range

Emissions
- Rich burn engine design easily meets emission requirements
- 0.5% O_2 rating meets U.S. EPA Spark Ignited Stationary NSPS Emissions for 2007/8 and 2010/11 with the use of aftermarket AFRC and TWC

Full Range of Attachments

Large variety of factory-installed engine attachments reduces packaging time

Testing

Every engine is full-load tested to ensure proper engine performance.

Gas Engine Rating Pro

GERP is a PC-based program designed to provide site performance capabilities for Cat® natural gas engines for the gas compression industry. GERP provides engine data for your site's altitude, ambient temperature, fuel, engine coolant heat rejection, performance data, installation drawings, spec sheets, and pump curves.

Product Support Offered Through Global Cat Dealer Network

More than 2,200 dealer outlets

Cat factory-trained dealer technicians service every aspect of your petroleum engine

Cat parts and labor warranty

Preventive maintenance agreements available for repair-before-failure options

S•O•S℠ program matches your oil and coolant samples against Caterpillar set standards to determine:
- Internal engine component condition
- Presence of unwanted fluids
- Presence of combustion by-products
- Site-specific oil change interval

Over 80 Years of Engine Manufacturing Experience

Over 60 years of natural gas engine production

Ownership of these manufacturing processes enables Caterpillar to produce high quality, dependable products.
- Cast engine blocks, heads, cylinder liners, and flywheel housings
- Machine critical components
- Assemble complete engine

Web Site

For all your petroleum power requirements, visit www.catoilandgas.cat.com.

STANDARD EQUIPMENT

Air Inlet System
Air cleaner — heavy-duty
Air cleaner rain cap
Service indicator

Control System
Governor — Woodward PSG mechanical
Governor locking — positive control

Cooling System
Thermostats and housing
Jacket water pump
Aftercooler water pump
Aftercooler core

Exhaust System
Watercooled exhaust manifolds
Dry exhaust elbow

Flywheel & Flywheel Housing
SAE No. 1 flywheel
SAE No. 1 flywheel housing
SAE standard rotation

Fuel System
Gas pressure regulator
Natural gas carburetor

Ignition System
Altronic III ignition system

Instrumentation
Service meter

Lube System
Crankcase breather — top mounted
Oil cooler
Oil filter — RH
Auxiliary oil reservoir
Oil pan — full sump
Oil filler in valve cover, dipstick — RH

Mounting System
Engine supports

Protection System
Shutoffs

General
Paint — Cat yellow
Crankshaft vibration damper and drive pulleys
Lifting eyes

OPTIONAL EQUIPMENT

Air Inlet System
Precleaner

Charging System
Battery chargers
Charging alternators
Charging alternators f/u/w c customer supplied shutoffs
Ammeter gauge
Ammeter gauge and wiring
Control mounting

Control System
PSG Woodward governor

Cooling System
Radiators
Non-sparking blower fan
Blower fans for customer supplied radiators
Fan drives for customer supplied radiators
ATAAC conversion
Aftercooler
Expansion tank
Heat exchangers

Exhaust System
Flexible fittings
Elbow
Flange
Pipe
Rain cap
Muffler

Fuel System
Fuel filter
Natural gas valve and jet kits

Ignition System
CSA shielded ignition
Wiring harness

Instrumentation
Gauges and instrument panels

Lube System
Auxiliary oil reservoir removal
Lubricating oil

Mounting System
Vibration isolators

Power Take-Offs
Auxiliary drive pulleys
Enclosed clutch and clutch support
Front stub shaft and flywheel stub shaft

Protection System
Gas valves

Starting System
Air starting motor
Electric air start control
Air pressure regulator
Air silencer
Electric starting motor — single 12- and 24-volt
Starting aids
Battery sets, cables, and rack

General
Damper guard

TECHNICAL DATA

G3406 Gas Petroleum Engine — 1800 rpm

		DM5302-01	TM8513-05	DM5084-03
Engine Power				
@ 100% Load	bkW (bhp)	242 (325)	160 (215)	205 (276)
@ 75% Load	bkW (bhp)	192 (244)	120 (161)	154 (207)
Engine Speed	rpm	**1800**	**1800**	**1800**
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	1219.2 (4000)	0	914.4 (3000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	55	45	0
SCAC Temperature	°C (°F)	54 (130)	—	—
Emissions*				
NOx	g/bkW-hr (g/bhp-hr)	35.29 (26.31)	37.47 (27.94)	20.69 (15.43)
CO	g/bkW-hr (g/bhp-hr)	2.15 (1.6)	1.9 (1.4)	20.69 (15.42)
CO_2	g/bkW-hr (g/bhp-hr)	620 (463)	685 (511)	699 (521)
VOC**	g/bkW-hr (g/bhp-hr)	0.21 (.16)	0.24 (0.18)	—
Fuel Consumption***				
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	9.96 (7037)	10.99 (7767)	10.49 (7418)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	10.53 (7443)	11.75 (8304)	11.44 (8082)
Heat Balance				
Heat Rejection to Jacket Water				
@ 100% Load	bkW (Btu/min)	200 (11,401)	160 (9081)	223 (12,709)
@ 75% Load	bkW (Btu/min)	173 (9822)	138 (7868)	178 (10,156)
Heat Rejection to Aftercooler				
@ 100% Load	bkW (Btu/min)	12.6 (716)	—	6.53 (372)
@ 75% Load	bkW (Btu/min)	7.9 (450)	—	3.86 (220)
Heat Rejection to Exhaust				
@ 100% Load	bkW (Btu/min)	161 (9180)	128 (7292)	140 (7991)
@ 75% Load	bkW (Btu/min)	125 (7091)	99 (5636)	105 (6022)
Exhaust System				
Exhaust Gas Flow Rate				
@ 100% Load	m^3/min (cfm)	38.74 (1368)	30.04 (1061)	33.1 (1168)
@ 75% Load	m^3/min (cfm)	30.33 (1071)	23.84 (842)	25.4 (900)
Exhaust Stack Temperature				
@ 100% Load	°C (°F)	526 (978)	560 (1040)	540 (1004)
@ 75% Load	°C (°F)	512 (953)	535 (995)	505 (942)
Intake System				
Air Inlet Flow Rate				
@ 100% Load	m^3/min (scfm)	13 (459)	9.68 (342)	10.84 (383)
@ 75% Load	m^3/min (scfm)	10.36 (366)	7.93 (280)	8.72 (308)
Gas Pressure	kPag (psig)	137-145 (19.9-21)	10.34-34.47 (1.5-5)	10.24-34.47 (1.5-5)

*at 100% load and speed, all values are listed as not to exceed

**Volatile organic compounds as defined in U.S. EPA 40 CFR 60, subpart JJJJ

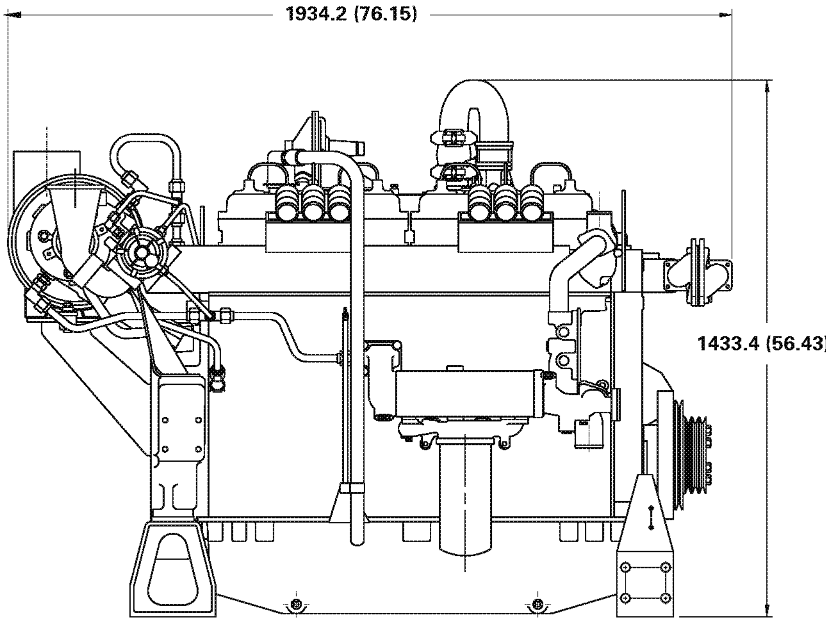
***ISO 3046/1

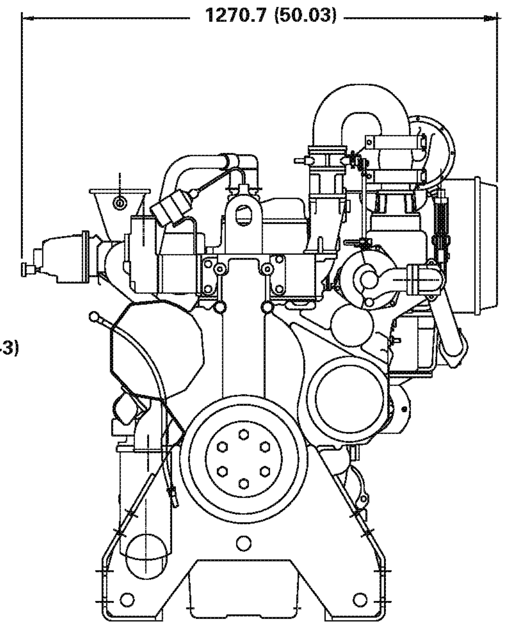
CATERPILLAR®

G3406 GAS PETROLEUM ENGINE

160-272 bkW (215-365 bhp)

GAS PETROLEUM ENGINE





PACKAGE DIMENSIONS		
Length	mm (in.)	1934.2 (76.15)
Width	mm (in.)	1270.7 (50.03)
Height	mm (in.)	1433.4 (56.43)
Shipping Weight	kg (lb)	1360.8 (3000)

Note: General configuration not to be used for installation. See general dimension drawings for detail.

Dimensions are in mm (inches).

RATING DEFINITIONS AND CONDITIONS

Engine performance is obtained in accordance with SAE J1995, ISO3046/1, BS5514/1, and DIN6271/1 standards.

Transient response data is acquired from an engine/ generator combination at normal operating temperature and in accordance with ISO3046/1 standard ambient conditions. Also in accordance with SAE J1995, BS5514/1, and DIN6271/1 standard reference conditions.

Conditions: Power for gas engines is based on fuel having an LHV of 33.74 kJ/L (905 Btu/cu ft) at 101 kPa (29.91 in. Hg) and 15° C (59° F). Fuel rate is based on a cubic meter at 100 kPa (29.61 in. Hg) and 15.6° C (60.1° F). Air flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and 25° C (77° F). Exhaust flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and stack temperature.

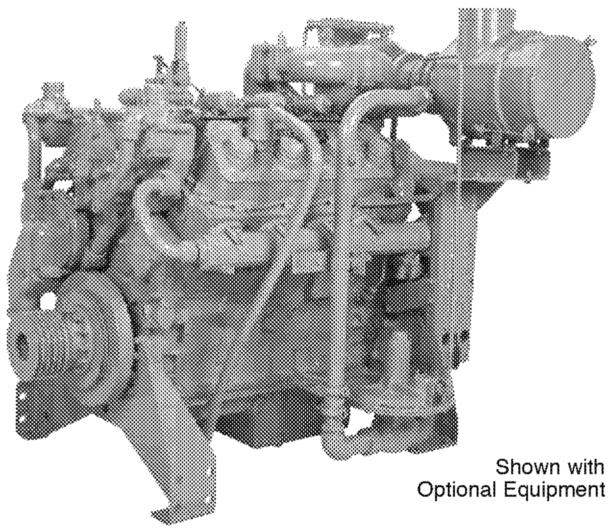
Performance Numbers: DM5302-01, TM8513-05, DM5084-03
LEHW0029-00 (11-09)
Supersedes LEHW0615-04

CATERPILLAR®

G3408 Gas Petroleum Engine

190-298 bkW (255-400 bhp) 1500 & 1800 rpm

2.0% O_2 Rating



Shown with Optional Equipment

CAT® ENGINE SPECIFICATIONS

V-8, 4-Stroke-Cycle

Bore	137 mm (5.4 in.)
Stroke	152 mm (6.0 in.)
Displacement	18 L (1099 cu. in.)
Aspiration	Naturally Aspirated or Turbocharged-Aftercooled
Governor and Protection	Woodward PSG
Combustion	Rich Burn
Engine Weight, net dry (approx)	1678.3 kg (3700 lb)
Power Density	5.6 kg/kW (9.3 lb/bhp)
Power per Displacement	22.2 bhp/L
Engine only Cooling System Capacity	54.9 L (14.5 gal)
Lube Oil System (refill)	46.2 L (12.2 gal)
Oil Change Interval	750 hours
Rotation (from flywheel end)	Counterclockwise
Flywheel and Flywheel Housing	SAE No. 0
Flywheel Teeth	136

FEATURES

Engine Design
- Improved reliability and durability
- Ability to burn a wide spectrum of gaseous fuels
- Robust diesel strength design prolongs life and lowers owning and operating costs
- Broad operating speed range

Full Range of Attachments
Large variety of factory-installed engine attachments reduces packaging time

Testing
Every engine is full-load tested to ensure proper engine performance.

Gas Engine Rating Pro
GERP is a PC-based program designed to provide site performance capabilities for Cat® natural gas engines for the gas compression industry. GERP provides engine data for your site's altitude, ambient temperature, fuel, engine coolant heat rejection, performance data, installation drawings, spec sheets, and pump curves.

Product Support Offered Through Global Cat Dealer Network
More than 2,200 dealer outlets

Cat factory-trained dealer technicians service every aspect of your petroleum engine

Cat parts and labor warranty

Preventive maintenance agreements available for repair-before-failure options

S•O•S℠ program matches your oil and coolant samples against Caterpillar set standards to determine:
- Internal engine component condition
- Presence of unwanted fluids
- Presence of combustion by-products
- Site-specific oil change interval

Over 80 Years of Engine Manufacturing Experience
Over 60 years of natural gas engine production

Ownership of these manufacturing processes enables Caterpillar to produce high quality, dependable products.
- Cast engine blocks, heads, cylinder liners, and flywheel housings
- Machine critical components
- Assemble complete engine

Web Site
For all your petroleum power requirements, visit www.catoilandgas.cat.com.

STANDARD EQUIPMENT

Air Inlet System
Air cleaner — single element with service indicator

Control System
Governor — Woodward PSG mechanical
Governor control — positive locking

Cooling System
Thermostats and housing
Jacket water pump
Aftercooler water pump
Aftercooler core

Exhaust System
Watercooled exhaust manifolds
Dry exhaust elbow

Flywheel & Flywheel Housing
SAE No. 0 flywheel
SAE No. 0 flywheel housing
SAE standard rotation

Fuel System
Gas pressure regulator
Natural gas carburetor

Ignition System
Digital ignition system

Instrumentation
Service meter

Lube System
Crankcase breather — top mounted
Oil cooler
Oil filter — RH
Auxiliary oil reservoir
Rear sump oil pan
Oil filler in valve cover and dipstick — RH

Mounting System
Engine supports

Protection System
Shutoffs

General
Paint — Cat yellow
Crankshaft vibration damper and drive pulleys
Lifting eyes

OPTIONAL EQUIPMENT

Air Inlet System
Air cleaner — dual element
Air inlet adapter
Precleaner
Air cleaner rain cap

Charging System
Battery chargers
Charging alternators
Ammeter gauge
Ammeter gauge and wiring
Control mounting

Control System
EG3P/2301A speed control governor
PSG electric governor
PSG pneumatic governor

Cooling System
Radiators
Non-sparking blower fan
Blower fan and fan drives for customer supplied radiators
ATAAC conversion
Aftercooler
Expansion tank
Heat exchanger

Exhaust System
Flexible fittings
Elbows
Flanges
Rain caps
Mufflers
Exhaust manifold

Fuel System
Dual gas regulator
Low energy fuel carburetor
Low pressure gas conversion
Propane and natural gas valve and jet kits
Fuel filter

Ignition System
CSA ignition
Ignition ground wiring harness
Power supply — digital ignition system

Instrumentation
Gauges and instrument panels

Lube System
Auxiliary oil reservoir removal
Lubricating oil

Mounting System
Vibration isolators

Power Take-Offs
Auxiliary drive pulleys
Enclosed clutch
Clutch support
Front stub shaft
Flywheel stub shaft
Pulley removal

Protection System
Gas valves

Starting System
Air starting motor
Electric air start control
Air pressure regulator
Air silencer
Electric starting motor — single 24-volt
Starting aids
Battery sets (24-volt dry), cables, and rack

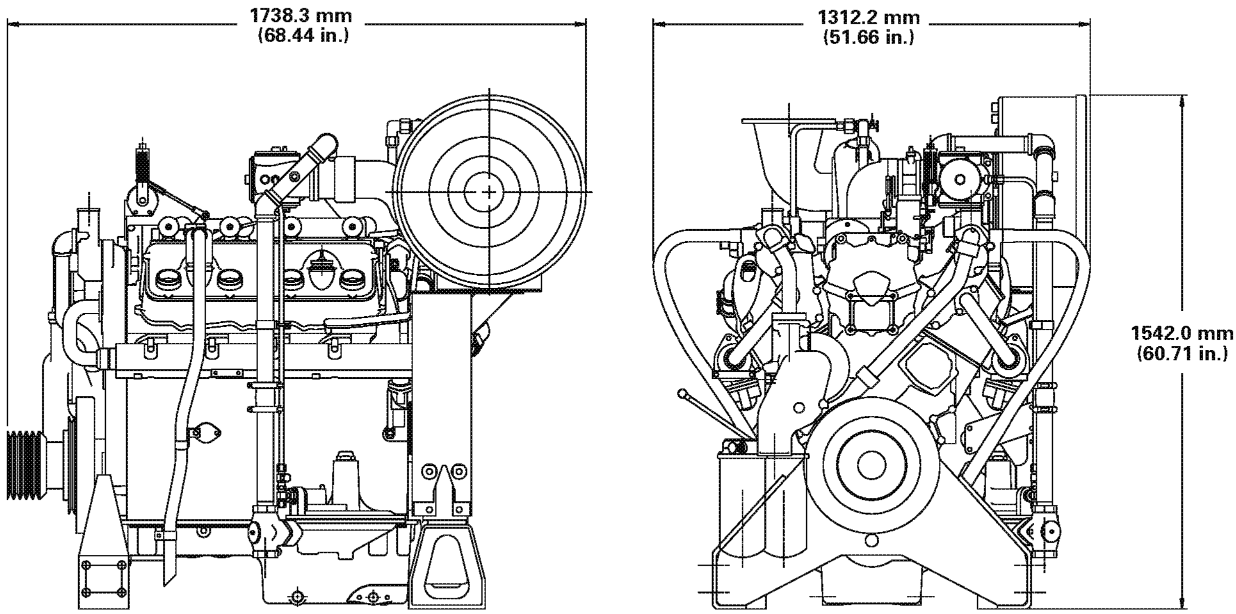
TECHNICAL DATA

G3408 Gas Petroleum Engine — 1500 and 1800 rpm

		DM8633-01	TM9151-05	TM9213-04
Engine Power				
@ 100% Load	bkW (bhp)	248 (332)	190 (255)	298 (400)
@ 75% Load	bkW (bhp)	186 (249)	143 (191)	224 (300)
Engine Speed	rpm	1500	1800	1800
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	914.4 (3000)	0	1219.2 (4000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	0	45	0
SCAC Temperature	°C (°F)	54 (130)	N/A	54 (130)
Emissions*				
NOx	g/bkW-hr (g/bhp-hr)	18.92 (14.11)	34.39 (25.64)	35.23 (26.27)
CO	g/bkW-hr (g/bhp-hr)	18.91 (14.10)	2 (1.5)	2.15 (1.6)
CO_2	g/bkW-hr (g/bhp-hr)	657 (490)	654 (488)	616 (459)
VOC**	g/bkW-hr (g/bhp-hr)	—	.3 (.22)	.21 (.16)
Fuel Consumption***				
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	10.62 (7507)	10.71 (7568)	9.92 (7008)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	11.14 (7874)	11.64 (8225)	10.40 (7350)
Heat Balance				
Heat Rejection to Jacket Water				
@ 100% Load	bkW (Btu/min)	279.73 (15,922)	179 (10,169)	253 (14,372)
@ 75% Load	bkW (Btu/min)	209.84 (11,944)	164 (9324)	217 (12,368)
Heat Rejection to Aftercooler				
@ 100% Load	bkW (Btu/min)	4.36 (248)	N/A	22.7 (1292)
@ 75% Load	bkW (Btu/min)	1.74 (99)	N/A	14.5 (828)
Heat Rejection to Exhaust				
@ 100% Load	bkW (Btu/min)	168.24 (9576)	151 (8583)	183 (10,382)
@ 75% Load	bkW (Btu/min)	121.07 (6891)	114 (6501)	136 (7749)
Exhaust System				
Exhaust Gas Flow Rate				
@ 100% Load	m^3/min (cfm)	38.37 (1355)	34.57 (1221)	45.08 (1592)
@ 75% Load	m^3/min (cfm)	28.94 (1022)	26.33 (930)	34.43 (1216)
Exhaust Stack Temperature				
@ 100% Load	°C (°F)	513.89 (957)	576 (1069)	490 (914)
@ 75% Load	°C (°F)	478.89 (894)	565 (1050)	464 (867)
Intake System				
Air Inlet Flow Rate				
@ 100% Load	m^3/min (scfm)	12.97 (458)	10.90 (385)	15.83 (559)
@ 75% Load	m^3/min (scfm)	10.25 (362)	8.35 (295)	12.52 (442)
Gas Pressure	kPag (psig)	10.3-34.5 (1.5-5)	10.34-34.47 (1.5-5)	137.9-172.4 (20-25)

*at 100% load and speed, all values are listed as not to exceed
**Volatile organic compounds as defined in U.S. EPA 40 CFR 60, subpart JJJJ
***ISO 3046/1

GAS PETROLEUM ENGINE



PACKAGE DIMENSIONS		
Length	mm (in.)	1738.3 (68.44)
Width	mm (in.)	1312.2 (51.66)
Height	mm (in.)	1542.0 (60.71)
Shipping Weight	kg (lb)	1678.3 (3700)

Note: General configuration not to be used for installation. See general dimension drawings for detail.

Dimensions are in mm (inches).

RATING DEFINITIONS AND CONDITIONS

Engine performance is obtained in accordance with SAE J1995, ISO3046/1, BS5514/1, and DIN6271/1 standards.

Transient response data is acquired from an engine/generator combination at normal operating temperature and in accordance with ISO3046/1 standard ambient conditions. Also in accordance with SAE J1995, BS5514/1, and DIN6271/1 standard reference conditions.

Conditions: Power for gas engines is based on fuel having an LHV of 33.74 kJ/L (905 Btu/cu ft) at 101 kPa (29.91 in. Hg) and 15° C (59° F). Fuel rate is based on a cubic meter at 100 kPa (29.61 in. Hg) and 15.6° C (60.1° F). Air flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and 25° C (77° F). Exhaust flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and stack temperature.

Performance Numbers: DM8633-01, TM9151-05, TM9213-04
LEHW0030-00 (11-09)
Supersedes LEHW0747-05

PRECISION ANALYSIS
GAS MEASUREMENT EMISSIONS TESTING LABORATORY
307.856.0866
www.precision-labs.com

Steffes Corporation
Dickinson, North Dakota

High Pressure Coanda Flare Tip
And
Low Pressure Ball Tip
Performance Testing

Test Dates:
July 24 & 25, 2012

Report Prepared By:

Steve Freeman

Steve Freeman
Project Manager

Report Contents Page(s)

PRECISION ANALYSIS GAS MEASUREMENT EMISSIONS TESTING LABORATORY
307.856.0866
www.precision-labs.com

Summary:

Precision Analysis was contracted to evaluate for compliance, the Steffes Corporation Flare Stacks. Field testing was conducted at the Kodiak Oil & Gas Inc., Smokey 16-20-32-16H3 location in McKenzie County south of Watford City, North Dakota. The high pressure Coanda flare tip and the low pressure Ball flare tip were tested to satisfy the specifications as described in 40 Code of Federal Reference (CFR) §60.18.

- Flare Operates with no visible emissions
  - High Pressure Flare. Confirmed no visible emissions at 27 mscfd and 1403 mscfd.
  - Low Pressure Flare. Confirmed no visible emissions at 17,280 scfd and 106.560 scfd.
- Flame is present at all times
  - Observed thermocouple data logging system of pilot temperature was operational.
- Exit Velocity is less than 400 fps
  - High Pressure Flare. Confirmed exit velocity less than 400 fps for flow rates up to 1.1 mmscfd.
  - Low Pressure Flare. Confirmed exit velocity less than 400 fps for all flow rates tested. Tested to 146,880 scfd.
- BTU content of gas in high and low pressure flare systems was greater than 1,000 BTU/scf which allows an exit velocity of 400 fps. Actual measurements during the test ranged from 1477 to 1774 BTU/scf.

The testing occurred on Tuesday, July 24 and Wednesday, July 25, 2012. Present during the tests were Dean Kovash, Jim Godlevsky, Todd Mayer, and Levi Jurgens from the Steffes Corporation. Kodiak Oil and Gas was represented by Travis Simnioniw and the testers for Precision Analysis were Scott Fairfield and Steve Freeman.

The high pressure Coanda flare tip and the low pressure Ball flare tip performance tests have shown the flares to be operating in accordance to specifications as described in 40 Code of Federal Reference (CFR) §60.18.

Methods:

The following EPA source emissions test methods were used.

<u>40 CFR Part 60, Appendix A</u>

- EPA Test Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate
- EPA Test Method 22 – Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares

<u>GPA METHOD 2261</u>

- GPA Test Method 2261 – Analysis for Natural and Similar Gaseous Mixtures by Gas Chromatography

<u>Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography</u>

Components to be determined in a gaseous sample are physically separated by gas chromatography and compared to calibration data obtained under identical operating conditions. A fixed volume of sample in the gaseous phase is isolated in a suitable inlet sample system and entered into the column.

Test Narrative:

High Pressure Flare

Precision Analysis conducted a gas analysis and verified the calibration of the ABB flow rate meter on the high pressure line prior to the testing. The flow exit area was then verified by inserting shims that were measured by a calibrated caliper. During the measurement verifications, the data from the analog proximity sensor (transducer) was recorded and used to establish the flow calibration chart. The flow and the transducer readings were recorded during the flare test so the exit velocity could be determined. The results are included in the following chart.

Table 1. Gas Flow Rates for 6" High Pressure Flare

Linear Trans. Displacement Reading (in)	Lin Trans Disp Zeroed (in)	Corrected Displacement Reading (in)	Flow Rate (scfd)	Exit Area (sq ft) (Calculated)	Exit Velocity (fps) (Calculated)
0.133	0	0	0	0.01806687	0
0.138	0.005	0.008	64000	0.019223149	38.53378715
0.145	0.012	0.019	125000	0.020813034	69.51217572
0.154	0.021	0.03	227000	0.022402918	117.2755613
0.161	0.028	0.037	299000	0.023414663	147.7983327
0.169	0.036	0.046	378000	0.024715478	177.0145847
0.174	0.041	0.049	431000	0.025149082	198.3541919
0.182	0.049	0.053	510000	0.025727222	229.437042
0.19	0.057	0.057	582000	0.026305362	256.0736889
0.197	0.064	0.061	660000	0.026883502	284.1478357
0.205	0.072	0.067	747000	0.027750712	311.5535716
0.217	0.084	0.077	839000	0.029196061	332.6013078
0.222	0.089	0.082	890000	0.029918736	344.2968286
0.232	0.099	0.09	1007000	0.031075016	375.0631284
0.244	0.111	0.1	1160000	0.032520365	412.846714
0.25	0.117	0.105	1258000	0.03324304	437.991988
0.262	0.129	0.115	1403000	0.03468839	468.1227962

Low Pressure Flare

Precision Analysis conducted a gas analysis on the tank vapor line prior to the testing. The flow exit area was then verified by using a dial indicator. During the measurement verifications, the data from the analog proximity sensor (transducer) was recorded and used to establish the flow calibration chart. Flow rates from the tanks were calculated using a S-Type Pitot tube fixed in the supply line to the flare. The flow and the Transducer readings were recorded during the flare test so the exit velocity could be determined. The results are included in the following chart.

Table 2. Gas Flow Rates for 3" Low Pressure Flare

Linear Trans. Displacement Reading (in)	Lin Trans Disp Zeroed (in)	Corrected Displacement Reading (in)	Pitot Tube Velocity-Raw	Flow Rate (scfd)	Exit Area (sq ft)	Exit Velocity (fps) (Calculated)
0.102	0	0	0	0	0	0
0.129	0.027	0.023	0.015	31680	0.00124	295.6989247
0.179	0.077	0.061	0.115	86400	0.0033	303.030303
0.213	0.111	0.088	0.204	115200	0.0047	283.6879433
0.22	0.118	0.094	0.229	122400	0.0049	289.1156463
0.232	0.13	0.103	0.27	132480	0.0055	278.7878788
0.238	0.136	0.107	0.285	136800	0.0057	277.7777778
0.244	0.142	0.111	0.304	139680	0.006	269.4444444
0.247	0.145	0.113	0.308	141120	0.0061	267.7595628
0.249	0.147	0.115	0.333	146880	0.0062	274.1935484

Visible Emissions

Visible emissions from the flare were determined by using EPA Method 22 as outlined in 40 CFR §60.18 paragraph (c) (1). Both flare stacks were observed at the high and low rates. The total observation time for each test was two hours. The observer also verified that the flame was present at all times during the tests. The Field observation sheets are included in Appendix C.

Appendix A

Gas Analysis Data

PRECISION ANALYSIS

Laboratory • Gas Measurement
Emissions Testing • Sample Collection

29 Country Acres Rd, Riverton, WY 82501 • Toll Free: (866) 985-0866 • E-mail: Info@Precision-Labs.com • Online: www.Precision-Labs.com

Run File	C:\Galaxie\data\12_07_24\Kodiak Run 13_4.DATA		
Method	S1_C10		
Operator	User1	**Analysis Date**	7/24/2012
Client:	Steffes Corporation	**Date Sampled:**	7/24/2012
Sample Identification:	Kodiak Run 1	**Purpose:**	Flare testing
Unique #:		**Pressure (PSI):**	48.8 PSIA
Temperature (DEG F):	89	**Sample Type:**	Onsite
Sampled By:	S. Fairfield	**County:**	McKenzie

Component	Mole %	BTU	GPM
Nitrogen (N2)	1.1538	0.0000	0.0000
Carbon Dioxide	0.6858	0.0000	0.0000
Methane (CH4)	59.5731	603.0798	0.0000
Ethane (C2)	18.8902	335.0731	5.0507
Propane (C3)	10.5339	265.6574	2.9013
iso-Butane (i-C4)	1.4945	48.7125	0.4889
Butane (C4)	4.0349	131.9355	1.2717
iso-Pentane (i-C5)	0.8573	34.3779	0.3134
Pentane (C5)	1.1849	47.6074	0.4294
Hexanes (C6)	0.7670	36.5599	0.3153
Heptanes (C7)	0.4301	23.7219	0.1984
Octanes (C8)	0.1784	11.1723	0.0914
Nonanes (C9)	0.0316	2.2182	0.0178
Decanes+	0.0148	1.1515	0.0091
Benzene	0.0888	3.3305	0.0248
Toluene	0.0569	2.5518	0.0190
Ethylbenzene	0.0028	0.1443	0.0011
Xylenes	0.0214	1.1152	0.0081
Totals	100.0000	1548.4092	11.1406

Specific Gravity from Composition			0.9271				
BTUs @	**14.730**	**Saturated (Ideal)**	1521.4608	**BTUs @**	**14.730**	**Saturated (Real)**	1530.7392
BTUs @	**14.730**	**Dry (Ideal)**	1548.4092	**BTUs @**	**14.730**	**Dry (Real)**	1557.8520
Compressibility			0.99394				

PRECISION ANALYSIS

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Run File	C:\Galaxie\data\12_07_24\Kodiak Run 24_4.DATA		
Method	S1_C10		
Operator	User1	**Analysis Date**	7/24/2012
Client:	Steffes Corporation	**Date Sampled:**	7/24/2012
Sample Identification:	Kodiak Run 2	**Purpose:**	Flare testing
Unique #:		**Pressure (PSI):**	45.0 psia
Temperature (DEG F):	89	**Sample Type:**	Onsite
Sampled By:	S. Fairfield	**County:**	McKenzie

Component	Mole %	BTU	GPM
Nitrogen (N2)	1.2555	0.0000	0.0000
Carbon Dioxide	0.6727	0.0000	0.0000
Methane (CH4)	62.6000	633.7223	0.0000
Ethane (C2)	17.7990	315.7183	4.7589
Propane (C3)	9.2802	234.0397	2.5560
iso-Butane (i-C4)	1.3015	42.4198	0.4258
Butane (C4)	3.5481	116.0178	1.1183
iso-Pentane (i-C5)	0.7904	31.6953	0.2890
Pentane (C5)	1.1172	44.8873	0.4049
Hexanes (C6)	0.7701	36.7085	0.3166
Heptanes (C7)	0.4685	25.8387	0.2161
Octanes (C8)	0.1844	11.5488	0.0944
Nonanes (C9)	0.0306	2.1465	0.0172
Decanes+	0.0172	1.3366	0.0106
Benzene	0.0915	3.4317	0.0256
Toluene	0.0588	2.6392	0.0197
Ethylbenzene	0.0011	0.0582	0.0004
Xylenes	0.0132	0.6907	0.0050
Totals	100.0000	1502.8993	10.2585

Specific Gravity from Composition			0.8982				
BTUs @	**14.730**	**Saturated (Ideal)**	1476.7429	**BTUs @**	**14.730**	**Saturated (Real)**	1485.1458
BTUs @	**14.730**	**Dry (Ideal)**	1502.8993	**BTUs @**	**14.730**	**Dry (Real)**	1511.4510
Compressibility			0.99434				

Run File	C:\Galaxie\data\12_07_24\Kodiak Run 36_7_24_2012 5_56_05 PM_4.DATA		
Method	S1_C10		
Operator	User1	**Analysis Date**	7/24/2012
Client:	Steffes Corporation	**Date Sampled:**	7/24/2012
Sample Identification:	Kodiak Run 3	**Purpose:**	Flare Testing
Unique #:		**Pressure (PSI):**	71.2 PSIA
Temperature (DEG F):	91.1	**Sample Type:**	Onsite
Sampled By:	S. Fairfield	**County:**	McKenzie

Component	Mole %	BTU	GPM
Nitrogen (N2)	1.1609	0.0000	0.0000
Carbon Dioxide	0.6673	0.0000	0.0000
Methane (CH4)	59.9011	606.4012	0.0000
Ethane (C2)	19.8039	351.2810	5.2950
Propane (C3)	10.6897	269.5868	2.9443
iso-Butane (i-C4)	1.4061	45.8292	0.4600
Butane (C4)	3.6111	118.0773	1.1382
iso-Pentane (i-C5)	0.6894	27.6451	0.2521
Pentane (C5)	0.9209	37.0028	0.3337
Hexanes (C6)	0.5527	26.3469	0.2272
Heptanes (C7)	0.3171	17.4883	0.1463
Octanes (C8)	0.1241	7.7739	0.0636
Nonanes (C9)	0.0241	1.6905	0.0136
Decanes+	0.0108	0.8384	0.0066
Benzene	0.0623	2.3362	0.0174
Toluene	0.0396	1.7768	0.0133
Ethylbenzene	0.0021	0.1074	0.0008
Xylenes	0.0167	0.8733	0.0064
Totals	100.0000	1515.0553	10.9183

Specific Gravity from Composition			0.9047				
BTUs @	**14.730**	**Saturated (Ideal)**	1488.6874	**BTUs @**	**14.730**	**Saturated (Real)**	1497.2861
BTUs @	**14.730**	**Dry (Ideal)**	1515.0553	**BTUs @**	**14.730**	**Dry (Real)**	1523.8064
Compressibility			0.99426				

Run File	C:\Galaxie\data\12_07_24\Kodiak Vapor 15_7_24_2012 5_00_01 PM_3.DATA		
Method	S1_C10		
Operator	User1	**Analysis Date**	7/24/2012
Client:	Steffes Corporation	**Date Sampled:**	7/24/2012
Sample Identification:	Kodiak Vapor 1	**Purpose:**	Vapor test
Unique #:		**Pressure (PSI):**	10 "
Temperature (DEG F):	78	**Sample Type:**	Onsite
Sampled By:	S.Fairfield	**County:**	McKenzie

Component	Mole %	BTU	GPM
Nitrogen (N2)	5.8016	0.0000	0.0000
Carbon Dioxide	0.6163	0.0000	0.0000
Methane (CH4)	43.2367	437.7006	0.0000
Ethane (C2)	19.4275	344.6032	5.1943
Propane (C3)	17.9997	453.9389	4.9576
iso-Butane (i-C4)	3.3742	109.9803	1.1039
Butane (C4)	0.0000	0.0000	0.0000
iso-Pentane (i-C5)	2.2881	91.7545	0.8366
Pentane (C5)	3.1765	127.6324	1.1512
Hexanes (C6)	2.0383	97.1655	0.8380
Heptanes (C7)	1.1109	61.2723	0.5124
Octanes (C8)	0.4395	27.5279	0.2251
Nonanes (C9)	0.0624	4.3727	0.0351
Decanes+	0.0245	1.9023	0.0151
Benzene	0.2296	8.6096	0.0642
Toluene	0.1364	6.1182	0.0457
Ethylbenzene	0.0024	0.1252	0.0009
Xylenes	0.0355	1.8536	0.0135
Totals	100.0000	1774.5570	14.9936

Specific Gravity from Composition			1.1262				
BTUs @	**14.730**	**Saturated (Ideal)**	1743.6727	**BTUs @**	**14.730**	**Saturated (Real)**	1758.9081
BTUs @	**14.730**	**Dry (Ideal)**	1774.5570	**BTUs @**	**14.730**	**Dry (Real)**	1790.0623
Compressibility			0.99134				

Appendix B

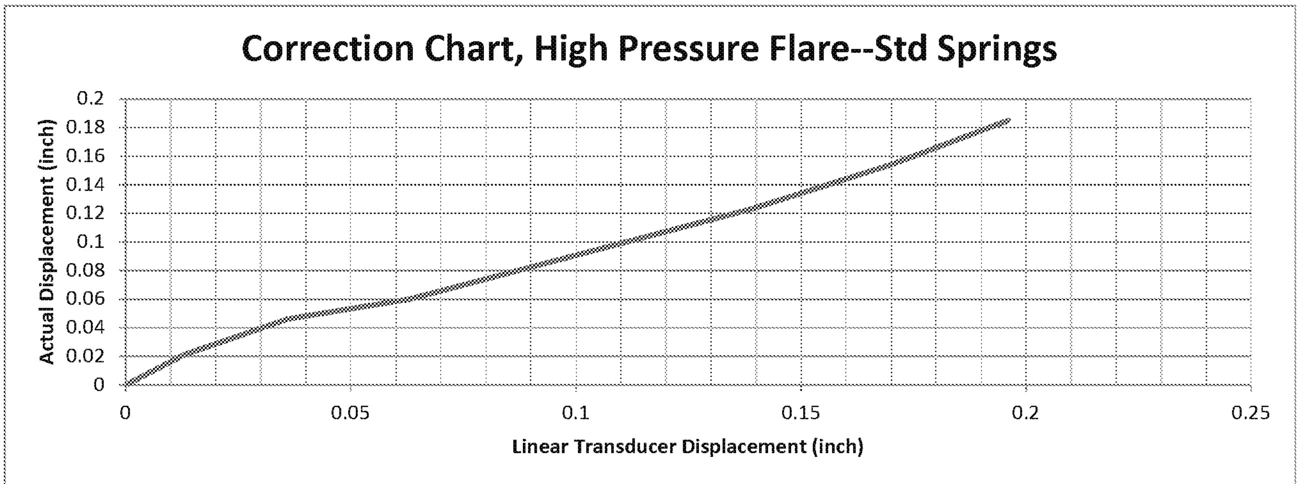
Flare Tip Calibration Data

Correction Table
Date: July 25, 2012
Description: High Pressure Flare (6" Coanda)--Standard Springs
Technician: Steve Freeman

Measured Disp (in) (shims)	Linear Transducer Reading (inch)	Lin Trans Rdg Zeroed (inch)
0	0.151	0
0.021	0.164	0.013
0.046	0.187	0.036
0.06	0.214	0.063
0.123	0.29	0.139
0.154	0.321	0.17
0.185	0.347	0.196

Example of interpolating data from chart

Measured Displacement	Lin Trans Rdg	Trans Reading	Corrected Reading
0.06	0.063	0.129	0.114710526
0.123	0.139		

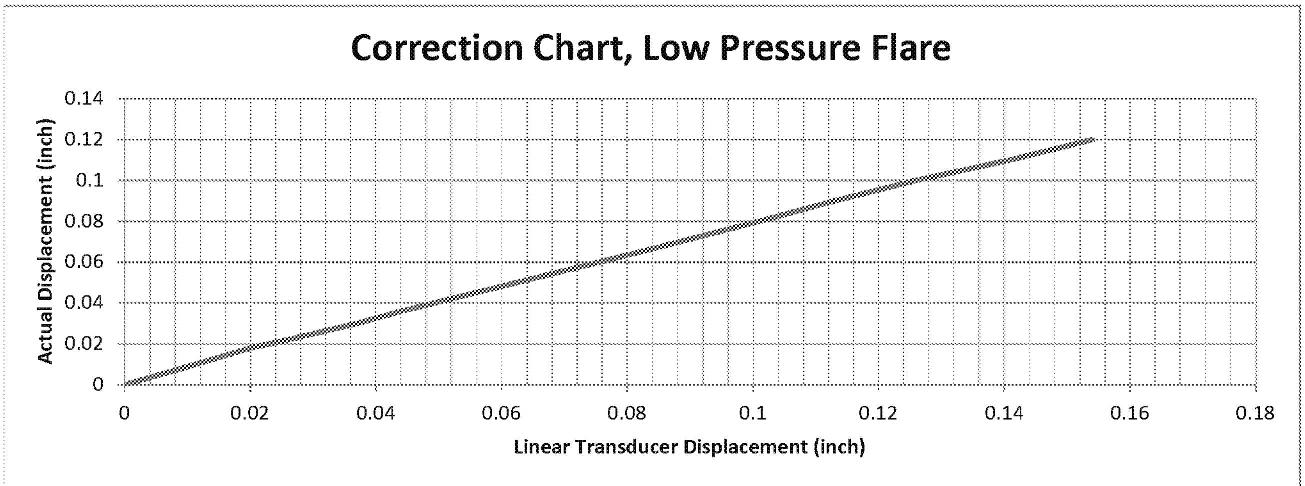


Correction Table
Date: July 25, 2012
Description: Low Pressure Flare
Technician: Steve Freeman

Measured Disp (in) (dial indicator)	Linear Transducer Reading (inch)	Lin Trans Rdg Zeroed (inch)
0	0.149	0
0.008	0.158	0.009
0.018	0.169	0.02
0.022	0.175	0.026
0.03	0.186	0.037
0.036	0.193	0.044
0.065	0.231	0.082
0.08	0.25	0.101
0.09	0.262	0.113
0.1	0.275	0.126
0.11	0.29	0.141
0.12	0.303	0.154

Example of interpolating data from chart

Measured Displacement	Lin Trans Rdg	Trans Reading	Corrected Reading
0.11	0.141	0.147	0.114615385
0.12	0.154		



Appendix C

Method 22 Field Data Sheets

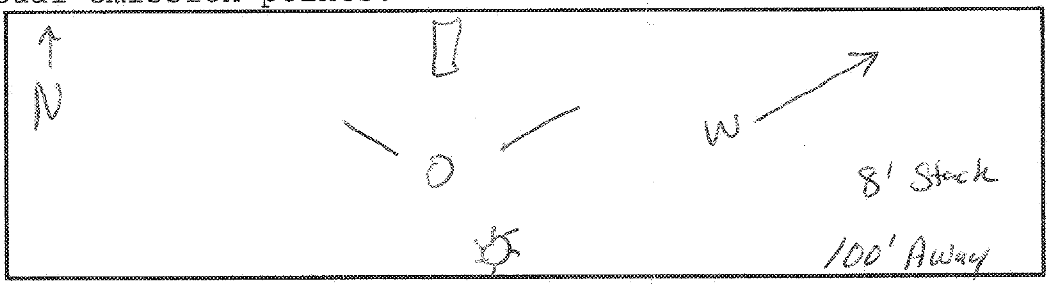
1177

High Pressure flare at Low flow of 27 mscfd

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Steffes Corp Location Kodiak, Smokey 16-20 32-16H3 Company Rep.	Observer Steve Freeman Affiliation Precision Date 7-24-12
Sky Conditions Pt Cloudy Precipitation None	Wind Direction NW Wind Speed 0-5
Industry	Process Unit flare

Sketch process unit: indicate observer position relative to source; indicate potential emission points and/or actual emission points.



OBSERVATIONS	Clock Time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	10:03	20:00	0
	10:30	20:00	0
	10:55	20:00	0
	11:20	20:00	0
	11:45	20:00	0
	12:10	20:00	0
End Observation	12:30	120:00	0

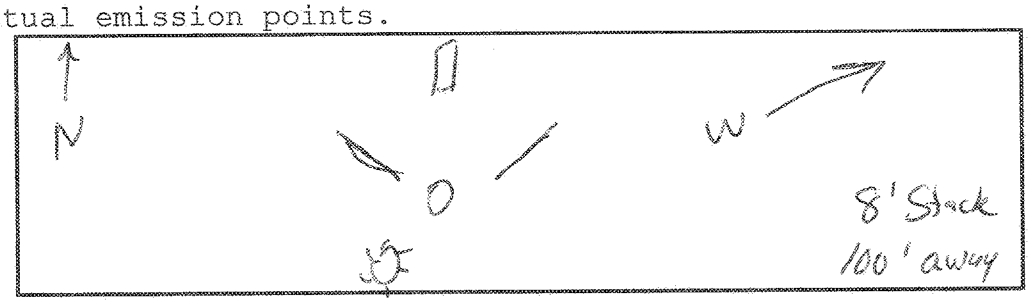
Figure 22-1

High pressure flare at High flow Rate of 1403 mscfd

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Steffes Corp Location Kodiak, Smokey 16-20-32-16H3 Company Rep.	Observer Steve Freeman Affiliation Precision Analysis Date 7-24-12
Sky Conditions Pt. Cloudy Precipitation None	Wind Direction NW Wind Speed 0-10
Industry	Process Unit flare

Sketch process unit: indicate observer position relative to source; indicate potential emission points and/or actual emission points.



OBSERVATIONS	Clock Time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	13:05	20:00	0
	13:30	20:00	0
	14:00	20:00	0
	14:25	20:00	0
	14:50	20:00	0
	15:15	20:00	0
End Observation	15:35	120:00	0

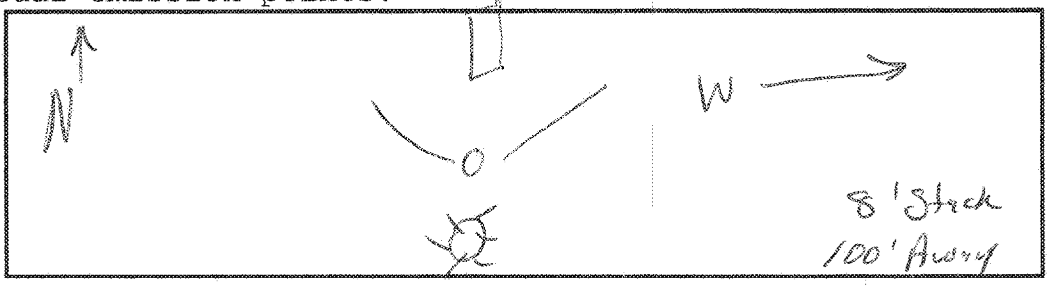
Figure 22-1

Tank Gas Low Pressure flare at High flow of 106,560 scfd

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Steffes Corp Location Kodak, Smokey 16-20-32-16H3 Company Rep.	Observer Steve Freeman Affiliation Precision Date 7-25-12
Sky Conditions Clear Blue Precipitation NONE	Wind Direction W Wind Speed 10-20
Industry	Process Unit

Sketch process unit: indicate observer position relative to source; indicate potential emission points and/or actual emission points.



OBSERVATIONS

	Clock Time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	09:55	20:00	0
	10:20	20:00	0
	10:45	20:00	0
	11:10	20:00	0
	11:35	20:00	0
	12:00	20:00	0
End Observation	12:20	120:00	0

Figure 22-1

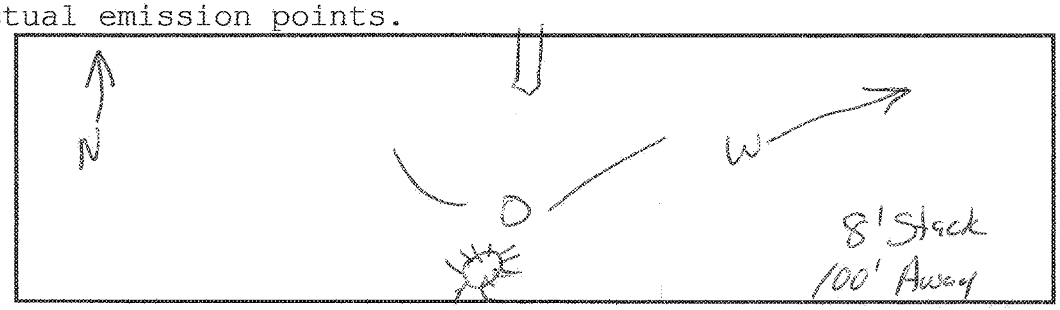
Tank Gas Low pressure flare at Low flow of 17,280 Scfd

1177

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Steffes Corp. Location Kodiak, Smokey 16-20-32-16H3 Company Rep.	Observer Steve Freeman Affiliation Precision Date
Sky Conditions Clear - Blue Precipitation NONE	Wind Direction NW Wind Speed 10-20
Industry	Process Unit flare

Sketch process unit: indicate observer position relative to source; indicate potential emission points and/or actual emission points.

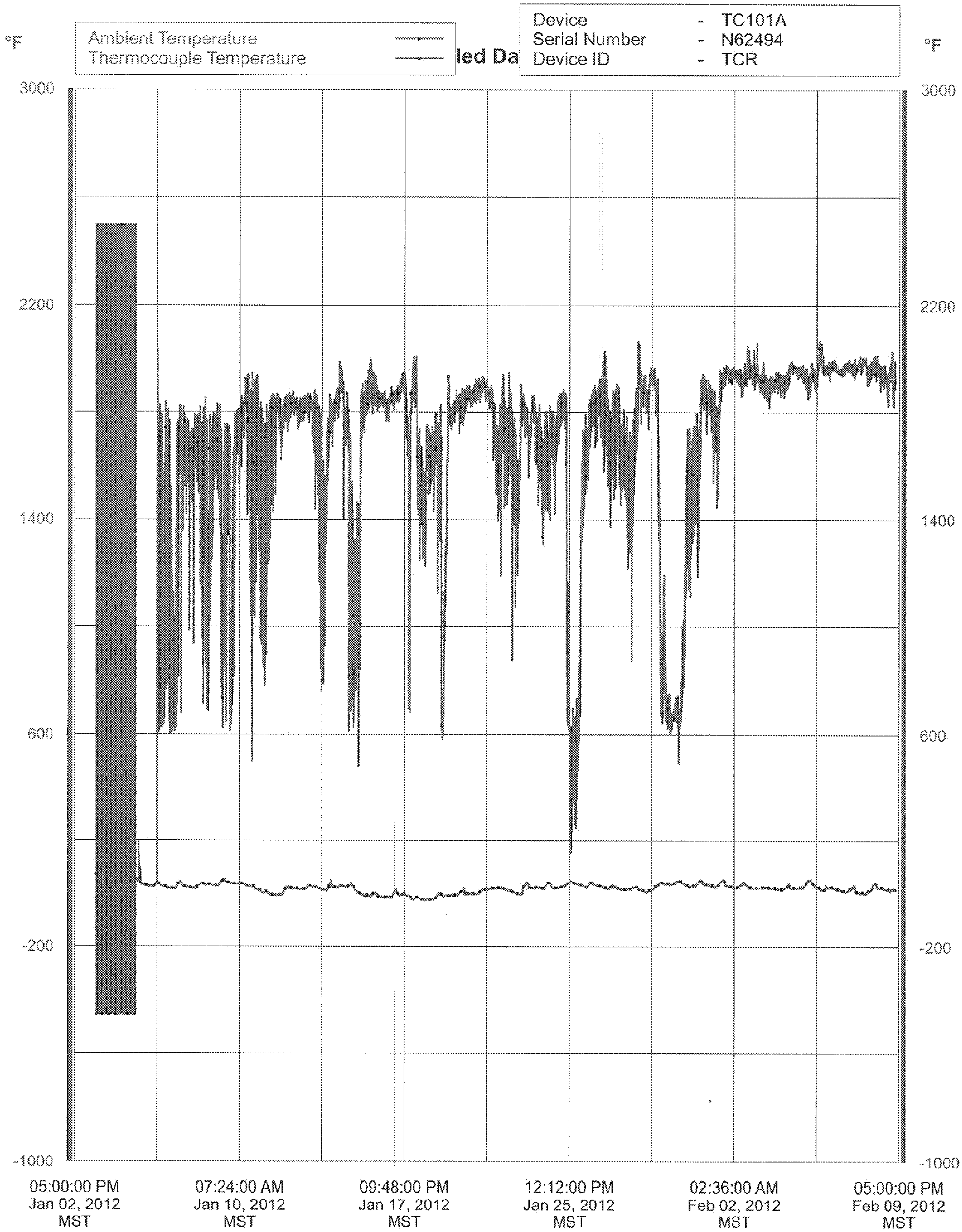


OBSERVATIONS	Clock Time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	12:30	20:00	0
	12:55	20:00	0
	13:20	20:00	0
	13:45	20:00	0
	14:10	20:00	0
	14:35	20:00	0
End Observation	14:55	120:00	0

Figure 22-1

Appendix D

Example Pilot Temperature Thermocouple Data



°F
Ambient Temperature
Thermocouple Temperature
led Da
Device - TC101A
Serial Number - N62494
Device ID - TCR
°F
3000
2200
1400
600
-200
-1000
3000
2200
1400
600
-200
-1000
05:00:00 PM
Jan 02, 2012
MST
07:24:00 AM
Jan 10, 2012
MST
09:48:00 PM
Jan 17, 2012
MST
12:12:00 PM
Jan 25, 2012
MST
02:36:00 AM
Feb 02, 2012
MST
05:00:00 PM
Feb 09, 2012
MST